AN INTRODUCTION TO AMERICAN CIVILIZATION

HAROLD RUGG

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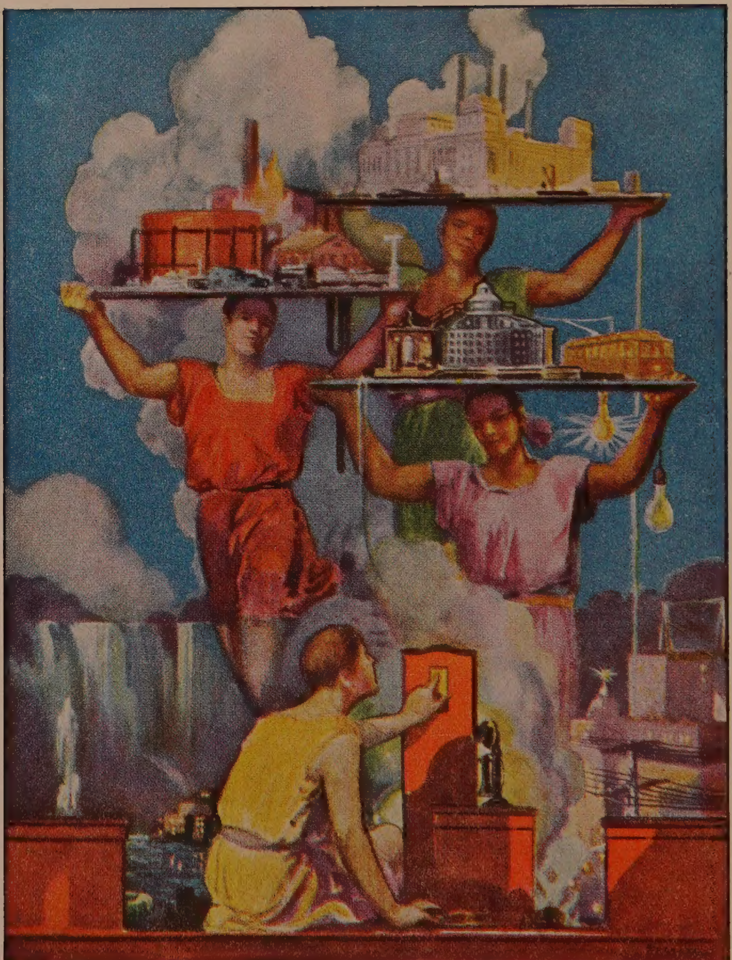

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AN INTRODUCTION TO AMERICAN CIVILIZATION

A Study of Economic Life in the United States

A TEXTBOOK IN GEOGRAPHY AND CIVICS
WITH HISTORICAL BACKGROUNDS

BY

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PREFACE

What is this Course in the Social Studies?

An Introduction to American Civilization is the first volume of the *Rugg Textbooks in the Social Studies.* The series comprises six *Reading Books*, six *Workbooks*, and six *Teacher's Guides.* These materials have been designed for use in the upper-elementary and junior-high-school grades.

The course as a whole introduces pupils to modern civilizations and their historical development. The present volume, *An Introduction to American Civilization,* is devoted chiefly to a study of the economic life of the United States. The second volume, *Changing Civilizations in the Modern World,* introduces pupils to the economic and social life of other lands. It considers ten characteristic civilizations of the modern world. These are the three great industrial nations — Great Britain, Germany, and France — and the changing agricultural countries — Russia, China, Japan, India, Argentina, Brazil, and Chile.

The third and fourth volumes comprise *A History of American Civilization.* Volume III deals with the economic and social development of the American people; Volume IV, with their political and cultural growth. Throughout every unit of these volumes historical developments are presented dramatically in their geographic settings. Thus the "history" and "geography" necessary to understand modern civilizations is distributed through the four volumes of the course.

Accompanying each of the *Reading Books* is a *Pupil's Workbook of Directed Study* and a *Teacher's Guide.* To be most effective the *Reading Book,* the *Workbook,* and the *Teacher's Guide* should be used in conjunction with one another.

An Introduction to American Civilization has been prepared to help young people to understand American civilization, by considering carefully the chief modes of living of our people. These

ways of living are presented in the form of thought-provoking problems in the *Pupil's Workbook of Directed Study* for *An Introduction to American Civilization.* Fundamental psychological principles of learning and detailed suggestions for teaching each unit of the course are presented in the *Teacher's Guide.*

The Importance of Introducing Youth to an Understanding of American Civilization

The author firmly believes that young Americans can be given an appreciation of the significant contemporary problems of living together. Current conditions in America throw into sharp relief the critical need of teaching our youth to understand American life and its relation to the modern world. Our schools are confronted with the difficult task of educating pupils to become informed, thinking citizens. During the past 150 years the rapid development of industrial civilization has produced problems of living together that baffle even the keenest adult minds.

It is of the utmost importance, therefore, that schools bend every effort to introduce our young people to the chief conditions and problems which will confront them as American citizens. That is the essential purpose of this new unified course in the social studies.

The Materials are based upon the Findings of Specialists in History, Geography, Government, and Economics

The foundation of this new course is a series of studies of the basic modes of living and the problems of modern life, the great movements through which institutions and problems have evolved, and the chief concepts and principles which, as history has proved, lie at the roots of living together.

Who knows best what these great institutions, problems, and trends are? Specialists on the frontier of thought who see society from a height, who detect its trends and the long-time movement of its affairs. From the mature thought of established students of modern life and its historical development, therefore, instead of from the single judgments of the textbook maker, the skeleton of

this course has been designed. It is based upon nine years of investigational work. In that time thirteen research studies of what to teach have been made.[1]

A Unified Course in the Social Studies

Why one general course rather than the separate subjects of history, geography, and civics? Because the chief aim is to understand modern life and how it came to be. To understand any institution or condition of life today the mind must utilize facts, meanings, generalizations, and historical movements that in the past have been set up in separate school subjects. For example, to understand the Westward movement of the American people one must see in close relationship the tide of immigration across the continent; the blazing of trails; the evolution of new land and waterways; the rapid development of new types of transportation; constantly changing forms of social life; the rise of cities behind the advancing frontier; the influence of mountains, deserts, climate, rivers, and soil upon travel, transportation, and communication; and where and how people live. All these factors must be tied closely together in their natural relationships. Hence the necessity of combining them into one general course instead of teaching them as separate subjects — history, geography, civics, economics, government, etc. In constructing this course one question has constantly been in the foreground of our thinking: What facts, historical movements, meanings, and principles do young people need to study together to understand American life?

In *An Introduction to American Civilization*, therefore, historical, geographic, economic, and other materials are studied *in close relationship*. Whenever history is needed to understand the present, history is presented. If geographic relationships are needed to throw light upon contemporary problems, those geographic relationships are incorporated. The same thing has been done with economic and social facts and principles.

[1] See Harold Rugg's *American Civilization and the Curriculum of the Social Sciences* (Bureau of Publications, Teachers College, Columbia University), John A. Hockett's *The Determination of the Major Social Problems of American Life* (Bureau of Publications, Teachers College, Columbia University), and Harold Rugg and John A. Hockett's *Objective Studies in Map Location* (Bureau of Publications, Teachers College, Columbia University). A complete account of all the studies upon which this course rests will also be presented in the forthcoming *Psychology and Teaching of the Social Studies*.

This has *not* caused a reduction in the amount of history or of geography included in the course. Rather, it has produced a sharp increase in the amount of these subjects in the curriculum, and in addition has added to the curriculum a wealth of new material.

Comparisons of the amount of history and geography in these four *Reading Books* with that of conventional textbooks in these subjects *should be based on a study of the total series and not on any one book.*

The Use of the Dramatic Episode

The readers of this book will encounter a second novel characteristic: *the frequent use of dramatic episodes.* If young people are to be brought to an understanding of our complicated civilization, it must be chiefly through the medium of words. Hence, the imperative need of dramatizing the past and present story of American civilization and its relations to the modern world. In this course each topic is illustrated by vivid episodes and by a wealth of maps, graphs, and pictorial material far in excess of their present use in textbooks. The substitution of this vivid episodical treatment for the encyclopedic one which characterizes many of our current school histories and geographies has necessitated a marked increase in the volume of reading material.

"Learning by Doing": the *Pupil's Workbook of Directed Study*

The very center of this course in the social studies is the *Workbook.* The chief goal of the social studies is active and intelligent participation in American civilization. To guarantee the attainment of this goal the school must organize its work around a core of dynamic pupil activities. *Young people grow in understanding only by participating actively in the study of the society around them.* Even to the present day the work in the social studies has consisted too much of memoriter recitation from the contents of encyclopedic textbooks in history, geography, and civics.

The very essence of this new course in social studies is a succession of pupil activities, dynamic and thought-provoking. Many optional suggestions for these activities are incorporated in the *Workbook* and presented as a series of problems. Each

problem of this course is an organized scheme of things for the pupil to do. Each unit compels him to find the answer to one or more important questions. The course, as presented in the *Workbook*, therefore, constantly confronts the pupil with stimulating problems, insight into each of which is important for an adequate understanding of American civilization. Hence, the *Workbook* is the very core of the course, and the *Reading Book* has been constructed, unit by unit, in close conjunction with it.

Planned Repetition

The fourth characteristic of this course is the carefully planned recurrence of important concepts, generalizations, and historical themes in varied settings. One of the besetting weaknesses of current school courses in history, geography, and civics is lack of planned repetition. In the present course this defect has been remedied by designing the entire course in terms of a carefully planned scheme of repetition. In preparing each topic of the course the outstanding concepts, generalizations, and historical themes that an educated mind should understand have been charted in advance. Episodes, narratives, statistical and graphic exhibits, pictures, and maps have been selected with the need for the illustration of these items clearly in mind. Hence the student will encounter the important meanings, principles, and movements over and over again, but constantly presented in new and varied settings.

Hundreds of Schools have coöperated in the Preparation of This Course, 1922–1929

How can one feel sure that this course, which on superficial examination may appear to be difficult, is within the comprehension and ability of the pupil?

It has passed through three experimental editions — the first was used in mimeographed form, 1921–1922; the second consisted of printed books used in 1922–1923 in more than 100 school systems; the third consisted of completely reconstructed printed books (known as the *Social Science Pamphlets*) used in more than 300 school systems, 1923–1929.

This series of books could not have been developed successfully

without the coöperation of a very large number of public and private schools. Hundreds of schools, located in more than forty states, have purchased and tried out under our direction copies of the experimental editions. In all, more than 600,000 copies of the *Social Science Pamphlets* were used by pupils between 1922 and 1929.

Furthermore, this present book has been written with a much simpler vocabulary than was used even in the third experimental edition. A scientific analysis of the completed manuscript shows that it falls within the comprehension of *sixth-grade* pupils.

Every kind of community in the United States — small towns, medium-sized cities, large cities — has made experimental use of these books. More than 50,000 tests taken by pupils have been returned to us for examination. The judgments of more than 1000 teachers have been obtained concerning needed revisions. Many round-table conferences have been held with small groups of teachers using the experimental editions. The theory of the course has been discussed with hundreds of audiences in the past seven years. Debates have been held with specialists in history and geography. Furthermore, careful measurements have proved that several thousand pupils studying the experimental edition achieved a markedly superior understanding of modern life and a distinctly higher ability in thinking about it than a group of 1500 pupils who had studied under similar conditions the conventional history-geography-civics courses.

The Course is based upon an Elaborate Program of Research[1]

Twenty-two thorough investigations have been made dealing with the following topics:

1. Thirteen studies of what to teach of the problems of contemporary life, of the chief trends of civilization, and of the central concepts and principles which educated minds use in thinking about them.

[1] The entire nine years of investigational work is reported in a forthcoming monograph, *American Civilization and the Curriculum of the Social Sciences* (Bureau of Publications, Teachers College, Columbia University). It will also be summarized in *The Psychology and Teaching of the Social Studies* (in preparation). Of the studies upon which this course is based the following have already been published: C. O. Matthews, *Grade Placement of Curriculum Materials in the Social Studies* (Bureau of Publications, Teachers College, Co-

2. Three scientific studies of grade placement of curriculum materials and of the development of pupil's abilities.
3. Six studies of learning and of the organization of curriculum materials, which have also contributed to the arrangement of the material in this course.

The Need for a Large Allotment of Time for the Social Studies

Finally, no adequate course in the social studies can be developed successfully in the time now allotted to it in most public and private schools. Our elaborate program of research and our seven years of work with experimental editions prove conclusively that *more* than 60 minutes of daily class time must be devoted to the social studies in order that young people may obtain even a partial understanding of modern civilization. The social-studies course should be the intellectual core of the school curriculum. It is earnestly hoped that schools will provide adequately for this central core by allotting to it a large amount of time.

An Important Caution about Accuracy in Using Facts

In this book there are many statements of fact, such as those of population, areas of countries and regions, amounts of coal, iron, and other raw materials produced, numbers of miles of railroad track, etc. These facts are necessary for an understanding of American civilization. We have tried to make sure that the facts are stated accurately. One difficulty has been encountered, however: that even the most reliable sources from which the statistics and other facts have been selected, — for example, the census publications of the United States government, the Statistical Abstract of the United States, the Statesman's Year Book, etc., —

lumbia University); Harold Rugg and John A. Hockett, *Objective Studies in Map Location* (Bureau of Publications, Teachers College, Columbia University); Hyman Meltzer, *Children's Social Concepts* (Bureau of Publications, Teachers College, Columbia University); Earle Rugg, *Studies in Curriculum Construction in the Social Studies* (State Teachers College, Greeley, Colorado); "The Social Studies in the Elementary and Secondary School," Part II of the Twenty-second Yearbook of the National Society for the Study of Education (Public School Publishing Company); Neal Billings, *A Determination of Generalizations Basic to the Social Science Curriculum* (Bureau of Publications, Teachers College, Columbia University).

do not always agree. It was necessary, therefore, to choose among them those statements which appear to us to be most accurate.

The reader will note the frequent use of round numbers in statements of number of inhabitants, amounts of production, distances, areas, etc. In most cases it is not important to remember the exact figures; it *is* important, however, to obtain a correct impression from the use of the facts. Hence, approximate numbers and estimates have been frequently used. The student should constantly ask himself: how reliable are these facts? He should learn that in the past 100 years the scientific way of doing things has made our records more and more accurate. Nevertheless, much improvement in this matter is still needed. In spite of great care in checking the facts that have been given, the reader may find instances in which correction should be made.

In Acknowledgment

This enterprise could not have been developed without the coöperative support and friendly and critical advice of many persons. First, there are several thousand progressive administrators and teachers who contributed criticisms and suggestions. From 1922 to 1929 inclusive these educational leaders gave unsparingly of their energy to the experimental trial of the tentative editions of these books. By their courage and vision in utilizing novel materials in the social sciences, they have put the children of American schools as well as myself in their debt.

Second, there is the administration of Teachers College, Columbia University, and of the Lincoln School. The American children who will use these materials owe a debt of gratitude to the deans of Teachers College and to the directors of the Lincoln School for permitting and encouraging the development of this course by experimental methods.

I have acknowledged with pleasure in the body of the text many instances of coöperation from publishing houses who permitted quotations from their publications and the reproduction of illustrative materials. Almost without exception requests for coöperation of this character have been cordially granted.

Without the unfailing encouragement of my friends, John R. Clark, Marshall Dunn, George Nugent, R. P. Nugent, Jr., and Jesse H. Newlon, it would frequently have been difficult to carry on.

I have indicated in the following list the names of the members of the research and editorial staff who contributed studies and materials to the various editions of these books. In the preparation of this edition, however, several of my associates have given such conspicuous and loyal assistance that I wish to acknowledge their contribution more specifically. First, Gertrude M. White, who has carried the burden of office management during the past four years; second, my colleague James E. Mendenhall, collaborator in the preparation of the *Pupil's Workbooks of Directed Study* and *Teacher's Guides*, who also reviewed critically the manuscript of each of the *Reading Books*. Finally, however, I wish to render special acknowledgment for the valuable editorial services of Frances M. Foster, assistant in the preparation of final manuscripts and in the reading of proof from 1923 to 1927 inclusive and from 1928 to date. The present form of *Reading Books*, *Workbooks*, and *Teacher's Guides* owes more than I can measure to her editorial insight and constant labor.

This statement of my indebtedness should not be permitted to close without referring to the unsparing efforts of the staff of Ginn and Company to produce a practicable, attractive, and teachable body of materials. But especially I wish to express my appreciation for the encouragement and support given by Messrs. Charles H. Thurber, Henry H. Hilton, and Burdette R. Buckingham.

HAROLD RUGG

NEW YORK

The following research and editorial staff contributed studies or materials utilized in the various editions of this series of books.

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VOLUME III · A History of American Civilization: Economic and Social

VOLUME IV · A History of American Government and Culture

VOLUME V · An Introduction to Problems of American Culture

VOLUME VI · Changing Governments and Changing Cultures

THE WORKBOOKS

VOLUME I · Pupil's Workbook of Directed Study to accompany *An Introduction to American Civilization*

VOLUME II · Pupil's Workbook of Directed Study to accompany *Changing Civilizations in the Modern World*

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AN INTRODUCTION TO AMERICAN CIVILIZATION

UNIT I

INTRODUCTION: THE AMERICAN STANDARD OF LIVING

Mechanical Man Obeys Human Voice

ELECTRICAL MAN ANSWERS QUESTIONS, TAKES ORDERS, FILLS JOBS, REPLACES THE WORK OF HUMAN BEINGS

Yesterday, at 150 Broadway, an electrical man by the name of "Televox" demonstrated what he could do before a large audience.

When addressed in the proper manner he answered questions, took orders, and did what he was told to do.

One such Mr. Televox is now a doorman. When a person approaches him and says "Open, sesame," swiftly and silently he opens the door. He will obey only the proper words, "Open, sesame," because he was so made.

Each of these electric men will answer only those questions he was made to answer. To command such a mechanical servant one must therefore know what he can do and the proper way to address him.

But one need not be near him. Suppose, for instance, you were a thousand miles from home. If you had a Mr. Televox at home, you could pick up the telephone, and when you hear Televox answer, say "How hot is the furnace fire?" Immediately he tells you *exactly* how hot it is. "Turn on the heat!" you say, and put down the receiver certain that it will be done.

Three electric men are now actually at work at the New York City reservoir, where they answer 'phone calls day and night, giving accurate reports on the water supply. They are honest, dependable workers, who carry out their orders with the speed of lightning. More of them will be put to work shortly. Who knows what they may soon be doing for all of us?[1]

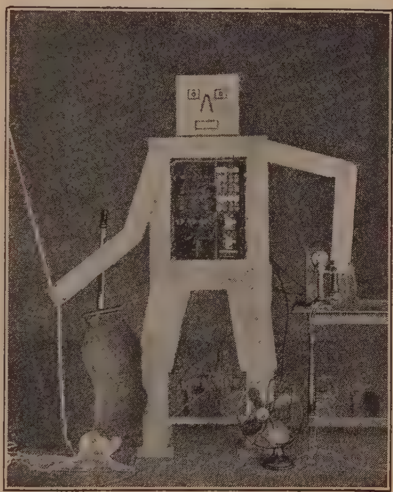
[1] Adapted from the *New York Times*, October 14 and 23, 1927.

CHAPTER I

WE LIVE IN A NEW AND CHANGING CIVILIZATION

A mechanical man! Will the wonders of our modern world never cease!

We talk to friends across the country, even across the ocean. Voices cross the continents through the air and are heard by millions of people at the same moment. We ourselves may soon be carried by fast plane from New York to Europe. And while we enjoy our vacation abroad, some of our work will be done by an electrical man that answers the telephone and carries out our orders just as a human being would, but without mistakes.



It is truly an age of magical change!

It is hard for us to realize that for hundreds of thousands of years people lived without any of these inventions. They were the slaves of nature, hunted by beasts, driven by storms. Only a few thousand years ago did men begin to learn how to use the wind, the water, and the things in the earth. Then suddenly, less than two hundred years ago, people discovered new ways to use nature's strength for their own needs and pleasure. With startling speed mechanical inventions followed these discoveries.

In the last one hundred and fifty years, people have probably changed their ways of living and thinking more than in many thousands of years that went before.

In beginning to study our new civilization in the United States, let us compare ways of living in 1800 with ways of living today.

Changes in American Homes

Let us look into Henry Smith's home in the new lands of Ohio about 1800.

The house is made of great logs chopped from the American forest. It has but one room, unplastered and not very large. In this room all the life of the home goes on. Here Mrs. Smith does the cooking, sewing, and spinning. A stone fireplace provides the only light for reading, the only place for cooking, and the only means of warmth. Henry and his boys made their rude tables, chairs, and other articles of furniture from the trees which they cut down to clear the land around the cabin. Little Julie, the daughter in the family, carries in from the spring the water for bathing and cooking and heats it in a great pot over the fire. All day long it is work, work, work. The day is filled with back-breaking labor for everyone except the baby.

Now think of the way you live and compare it with the Smith home of 1800.

Your family lives in several rooms, well heated in winter by a furnace and perhaps cooled in summer by electric fans. You turn on the gas or push a button, and there is good heat for cooking or light for reading. You turn a faucet, and water, hot or cold, runs into your bathtub or kitchen sink. Washing machines and sewing machines, electric irons and vacuum cleaners, cut down the drudgery of housework. What useful thing is there that you cannot buy for your home either by going to the stores or by sending to a neighboring city for it? What a wealth of books and magazines you have any time you want them!

About 1800

Today

Changes in Food-Getting

In 1800 the diet of the Smith family was simple. During the winter it consisted largely of salt pork, corn bread, and potatoes. Many times food was scarce, and there was little variety at any time. In the spring they raised their own vegetables on their own lands, and that was about all they had.

But what a difference today! The corner grocery has taken the place of the corner cupboard.

"Hello, is this the Browning grocery? This is Mrs. Warren, 87 Cedar Street. Please give my little boy a loaf of wrapped bread, a pound of granulated sugar, a can of boned chicken, and five pounds of potatoes. Have you some good Florida oranges? I'll take half a dozen. And send me a pound of Chinese green tea and a package of Smyrna figs. That's all. Good-by."

Each day into tens of thousands of meat markets, dairies, bakeries, and grocery stores come telephoned orders for kinds of food that could not have been bought in 1800. Indeed, many of these kinds of food were not even raised in the country at that time. Today, in most of the communities of our country, people can telephone to stores and order their daily supply of food.

The greater variety in our food today in America is not, however, the most important thing about it; the interesting fact is that much of it comes to us prepared, ready for use. Meats, vegetables, and fruits can be bought in tins. A meal that in 1800 would have taken most of the day to prepare can now be served in a few minutes after it is delivered from the grocery store. Prepared foods mean a tremendous saving in time and energy.

About 1800

Today

Changes in the Making of Clothing

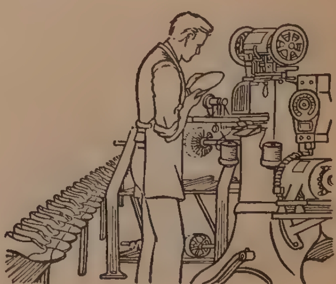
Henry Smith's cousin, William, did not go West in 1800 into the new lands of Ohio but stayed in his New York village making shoes for a living. He sat on a low wooden bench with a leather-covered seat at one end. At the other end were his various knives and awls and rasps. Sitting with his lapstone, hammer, awl, and pincers, his mouth full of nails, William laboriously cut and pulled and tacked, hammered and scraped and rubbed. By fast work he could finish a pair of shoes in two or three days. But while they were strong and durable, these shoes were far from fancy in style.

Today hundreds of people work together in a factory to make our shoes. They use more than 150 different machines in the making of each pair. With the most improved machinery they make a pair in from 30 to 40 minutes (not counting the time required for drying), and they produce thousands of beautiful shoes every day.

The same contrast is true of the making of other kinds of clothes. In the pioneer home yarn was spun and cloth for the family's clothes was woven by hand by the women of the family. After the cloth was woven it had yet to be cut and sewed by hand. You can understand why clothes were precious things in 1800.

But in this machine world of today, how differently the work is done! Gone are the old spinning wheels. Hand looms are merely interesting curiosities. Today thousands of spinning and weaving mills produce huge quantities of yarn and cloth, and the machines of many garment factories cut and sew our clothes.

About 1800



Today

Magical Change in Transportation and Communication

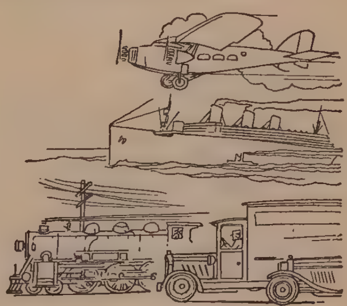
The most striking contrast between life in 1800 and today is the swiftness and ease with which we can travel from one part of the country to another. For example, many people, in a great city like Chicago, live 40 or 50 miles away from their place of work, and yet travel back and forth nearly every morning and night. In 1800 this journey would have taken two or three days. Instead of riding in a comfortable train or driving a powerful automobile along a smooth, well-paved road our forefathers walked or traveled by stagecoach or on horseback. The principal roads were fair in good weather but almost impassable after prolonged rains in the spring. The backwoods roads were little more than wilderness trails and could be traveled only on foot or on horseback. A distance of 20 miles was a long day's journey on most roads; under the best conditions 40 miles was fine traveling.

Today by using airplanes by day and express trains by night we can cross the entire continent in two days. The remote regions of our country are joined together by a nation-wide system of fine paved roads.

Communication (that is, the sending of messages from one place to another) has also speeded up. In 1800 it was no more rapid than the fastest transportation. Today we can speak by telephone to friends in any city in the country, — indeed, even in London, — within a few minutes' time. By radio words are sent swiftly through the air. Explorers in the cold regions near the south pole speak each day to their friends in the United States.

Magical change in transportation and communication!

About 1800



Today

Changes in Kinds of Power

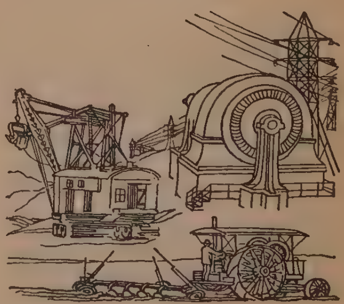
There are several reasons for the astonishing changes in the way in which people live. The most important reason, however, is the discovery of how to make mechanical power, or the power used in driving machinery.

In 1800 it was largely the muscles of men and animals and the water and the wind which provided the power to do work. Henry Smith ground his corn by hand. How slow and difficult it was to turn the heavy stones! Even in the town, a whole day away by horseback, it was the slow-turning water wheel or windmill that produced the necessary power. Everywhere the fields were plowed by the aid of horses or oxen and the wooden plow. The harvest was reaped by means of the sickle or scythe. The Erie Canal was dug (1817–1825) by hundreds of men with pickax and shovel.

Today the cultivating, harvesting, and preparing of food is done rapidly and easily by machinery. Nearly a hundred years after the completion of the Erie Canal, giant, power-driven steam shovels and other huge machines cut the Panama Canal (opened 1914) through a great mountain seven miles thick. Man's muscles alone in that hot and disease-infected tropical land would never have been able to connect the Atlantic and the Pacific Ocean.

Instead of aching muscles, it is now hissing steam and silent electricity which provide power. The waters of scores of rivers, crashing down upon swiftly turning water wheels, make electrical energy that is carried along copper wires to turn the wheels of thousands of machines. With the aid of a machine the strength of the worker is multiplied enormously.

About 1800



Today

Summing up Important Changes since 1800 that affected the Masses of People in the Country and the Small Towns

1800	Today
1. Small, rough-hewn wooden houses; few rooms, ill-protected from cold and heat; few household conveniences.	1. Many-roomed, weatherproof houses and apartments; substantially constructed of brick, concrete and steel, as well as wood; equipped with many conveniences.
2. Few, simple foods, raised by the aid of crude tools on the family's farm and prepared within the home; not much variety and food often scarce; food-getting very dependent upon the weather.	2. Many varieties of food, often grown in states or countries far from the family home; prepared by machines in large quantities and brought to the community by a world-wide system of transportation and communication.
3. Simple, plain clothing of cloth, hides, and other materials prepared by the family; little variation in style in the homemade garments.	3. Varied and attractive clothing made in large quantities with the aid of special machines, from materials gathered all over the world; purchased in local stores.
4. Only necessary traveling done; trails and roads few and bad; travel only on foot, on horseback, or in crude wagons or boats; the sending of messages and news as slow and difficult as travel.	4. A great deal of travel both for business and pleasure; made safe and convenient by a nation-wide system of fine roads, railways, and waterways; messages and news sent swiftly by means of post offices, telegraphs, telephones, and wireless.
5. The muscles of men and animals and the force of wind and water did the work; people were dependent upon "natural" power; hence work was laborious and inefficient.	5. Steam, gasoline, and electric engines provide vast quantities of mechanical power; this drives the machines that do most of our work economically and efficiently.

Of course, we should not think that all people in 1800 were pioneers like Henry Smith's family. In the growing cities along the Atlantic coast, — Boston, New York, Philadelphia, — there were many well-to-do merchants, lawyers, and owners of sailing ships. The large farms of Virginia and states farther south were owned by wealthy gentlemen who had servants and bought their fine silks and satins from London merchants. Even the shoe-

makers and other workers in the towns had better houses than the rough, one-room log cabins of the new settlers west of the Appalachian Mountains. But on the whole the great majority of the American people were poor and hard-working. They traveled little, had almost no schooling, and read few books. To a large extent the people of each community, — that is, of each settlement, village, or town, — depended upon their own labor for what they needed in order to live.

Notice, however, the contrast between the living of the pioneer communities of 1800 and that of their descendants in the same places, as shown by the chart on page 9.

To Those who use These Books

You are an American living in a new civilization that gives you great opportunities. In less than two centuries your country has changed from a few scattered settlements along the eastern seacoast to a well-populated country of 3,000,000 square miles. In this time it has become the wealthiest country on earth. *Compared with other people of the world* the American people are physically comfortable. Practically all of them are moderately healthy. Nearly all have enough to eat, a place to sleep, and fairly good clothing to wear.

Most Americans do not have to labor more than eight hours a day. Practically all of them can find work by which to earn a living. Many of them are engaged in dangerous and laborious occupations, but all have some leisure for recreation.

You live in a country, furthermore, where nearly all children go to school in healthful, comfortable buildings. Compared with peoples of other nations, you have many newspapers, magazines, and books to read and many libraries in which to enjoy them. You have many theaters and other places of recreation.

Though you will soon be a grown-up citizen of the United States, you do not have to wait until you are older to know something about the world in which you are living. You, as an American citizen, should begin now to understand the society in which you live. You should try to understand why people around you think and act as they do.

In this book we are trying to help you to understand the world we live in today, and how that world became what it is. It is not only possible for you to understand many of the difficult problems of our new civilization; it is possible also for you to help in solving them. To do so, you should learn some of the important facts about the modern world. You should then form your opinion according to the facts you have learned. There is nothing more needed by America and the rest of the world today than citizens whose minds are *open to the consideration of all the facts.* Try, therefore, to keep an open mind about every problem that you study.

INTERESTING READINGS FROM WHICH YOU CAN GET ADDITIONAL INFORMATION[1]

Books

CRUMP, IRVING. Og, Son of Fire. Dodd, Mead & Company, New York, 1922.
A fine imaginative story of how men lived in early times.

*MARSHALL, LEON C. Readings in the Story of Human Progress. The Macmillan Company, New York, 1926.
Chapter I presents a short account of the development of mankind during prehistoric times.

*VAN LOON, HENDRIK W. Ancient Man. Boni & Liveright, New York, 1922.
An interesting and well-illustrated account of the way people lived in early times.

VAN LOON, HENDRIK W. The Story of Mankind. Boni & Liveright, New York, 1921.
In this book the reader will find a short history dealing with the religious, political, and economic life of mankind through the ages.

Magazine Articles

*"Making the Televox do your Work," *Literary Digest*, November 19, 1927, pp. 21–22.
"Why we are living Better," *Literary Digest*, July 23, 1927, pp. 54–56.

[1] The references which are marked by a star are especially good. All double-starred references are particularly valuable.

CHAPTER II

"THE RICH MAN OF THE EARTH"?

Throughout her history the United States has been thought of as a land of golden opportunity. Starving peasants in Russia, struggling mechanics in Germany and England, farmers striving

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Fig. 1. In 1626 the Indians sold the island of Mana-hatta to white men for $24. In 1923 each acre of land on that part of this same island, which is shown in the picture, was estimated to be worth more than $1,000,000

to make a living on poor land in Scandinavia, gardeners on tiny farms in Italy, — all have regarded it as "the promised land." There, they thought, one would find rich land ready to be cultivated. There, factories would provide work for countless laborers. There, mines of coal, iron, and even precious metals would lie ready for the miner's shovel.

It is now more than 300 years since the first European settlers came to live in North America. Within that time the entire con-

tinent has been settled. Great forests have been cut down; land has been divided into farms; coal, iron, and gold have been mined in great amounts; and many villages, towns, and cities have grown up. It seems almost unbelievable that all this should have taken place in such a short period of time. To settle Asia and Europe required thousands of years. The change in the North American continent was so rapid that by comparison it seemed like magic. In 300 years a continent of prairies and forests, plains and mountains, has been transformed into a vast country of farms and villages and cities.

Today, therefore, Europeans consider the United States a golden country. Even American travelers of only moderate wealth are regarded as "millionaires." So widespread has the belief in our wealth become that cartoonists portray Uncle Sam as a fat, rich man with a contented look on his face, as is shown in figure 2. Is this a fair picture of Uncle Sam?

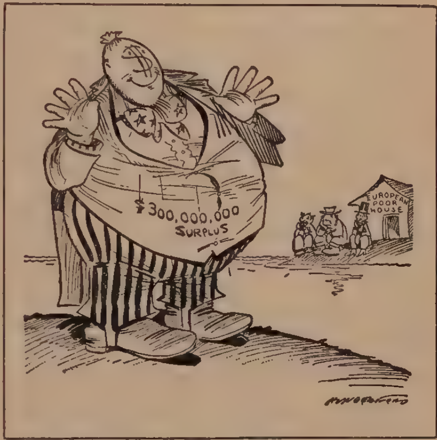

FIG. 2. What is the cartoonist trying to show by this picture? (Courtesy of the *Pittsburgh Sun*)

Our first task is to make a careful study of the facts concerning our wealth. We shall ask, "Do they support the statement that the United States is the wealthiest country on earth?" In order to answer our question intelligently we must have clearly in mind what we mean by "wealth." As you read the following story, therefore, try to decide with which points you agree.

WHAT IS WEALTH?

A sharp debate was going on in the room of the Social Science Club of the George Washington Junior High School.

"America is a wealthy country. I tell you, she is the wealthiest country on earth."

"I don't believe we are anywhere near as rich as Great Britain. *She* owns one fourth of the earth. What do you mean by 'wealth' anyway?"

"Why," said John Rogers, in answer to the question, "why — er — wealth is — it's the money you have in the bank. Mr. Hilbert, the president of the bank, is a wealthy man. We say he is a wealthy man because he has lots of money in the bank. So I think wealth is money — dollars."

"But, John," broke in Elizabeth Warick, "Mr. Johnson owns factories and a lot of automobile trucks, and in his factories are hundreds of machines. I think those are examples of wealth."

"I think wealth is anything you can make money out of," said Helen Briggs, trying to make the case broader, "like an apartment house, a laundry, or a store, like a —"

"Well, then," interrupted Ben Pillsbury, who had been sitting quietly taking it all in as he watched a sidewalk game through the window, — "well, then, are the pictures in Mr. Hilbert's library wealth? You can't make money out of them."

"Good point, Ben," exclaimed Mr. Harris, the teacher, who had overheard the conversation as he entered the room. "What about it?"

Several members of the club spoke at once, each eager to illustrate the new point.

"Of course the pictures are wealth." — "Sure, and Mr. Hilbert's house itself, the big mansion on the hill, that's wealth, too." — "Yes, and the clothes you wear, too, they are wealth; and the books that people write."

The discussion ran on until finally the president of the club summed up the matter by putting a question. "Well, then, to get the matter before us, is there anything that isn't wealth?"

What do *you* think? Is wealth only money? Is it also such things as houses, automobiles, oil, iron, and steel? What about wheat and corn — are they wealth? What about railroads, telegraphs, telephones, lumber? What about people themselves? Are the people in the United States a part of the wealth of our country? Mr. Hilbert has a wife and three children. Are they wealth?

Evidently we must decide what we mean by wealth in order to answer the question concerning the wealth of our country. Try to form an opinion about this important matter.[1]

We are ready now to consider the question Is the United States the richest country on earth? To do so we shall compare our resources and goods with those of the rest of the world.

The Wealth of the United States in Natural Resources and in Manufactured Goods

First, what do we mean by the world's "natural resources"? We mean the world's land, its iron, coal, oil, and other minerals, its natural gas, its water, its forests. Natural resources, therefore, are the things that are found in and upon the earth with the making of which man has had nothing to do.

Second, what do we mean by the world's "goods"? We mean the world's railroads, telephones, telegraphs; we mean the cotton cloth and the woolen goods, the wheat and other cereals, and the cotton that is grown upon its farm land. We mean the sheep that produce wool for our clothing; the paper that is so necessary in the modern world. We mean the rubber upon which the world rides in its automobiles and without which many necessities, as well as luxuries, could not be made. We mean almost numberless other things that people manufacture.

What share of these natural resources and manufactured goods does the United States have? If we can find the facts, we shall have the answer to our question, Is Uncle Sam "the rich man of the earth"? In the following pages you will study ten examples of the resources and goods which are so necessary to this new civilization in which we live.

1. What share of the world's land does the United States possess?

For more than 200 years land was the American's chief kind of wealth. There were few people on the continent and plenty of free land. Throughout the 1700's and 1800's as the frontiers-

[1] After you have read this chapter be sure to study the suggestions in the Workbook about this matter.

man in North America pushed westward he found acres of land from which to choose his own. Free land was his for the taking.

So, for more than two centuries, immigrants settled the land of the North American continent. Today the United States reaches almost 3000 miles from west to east and more than 1000 miles from north to south. It extends from the Atlantic Ocean to the Pacific Ocean and from Canada to Mexico.

Our country now comprises a huge area: 3,026,789 square miles of territory. In comparison with it the land area of the entire earth is 57,255,200 square miles. Although the United

Fig. 3. With this map you can compare in a general way the area of the United States with that of the entire earth

States is only one of scores of countries in the world, it includes about one twentieth of the earth's area. So you see we have a large share of the world's land. Not only is the area large, but it includes every kind of land,— forests, plains, mountains, deserts, valleys, and sea coasts. Within its boundaries is a great central region, consisting of plains and prairie land, excellent for raising wheat and corn and other crops. West of the Mississippi River and east of the Rocky Mountains is a great stretch of land on which millions of cattle can graze. Hundreds of thousands of acres of forest lands are scattered about in the hill and mountain regions of the East and the West. Later you will learn of the rich coal mines in the Appalachian Mountains, in the central plains, and in parts of the Far West, and of the valuable iron mountains in Minnesota.

2. What share of the world's population lives in the United States?

America's wealth lies especially in her great area and in her valuable iron mines, coal mines, oil wells, waterfalls, and great forests. But these resources would be valueless were it not for her people. Land is of value only when it is used; iron, coal, and oil only when they are mined and put to use. This is true of all the great natural resources. Hence we say that people are a most important form of a nation's wealth, for they do the work of a

FIG. 4. In 1925 the population of the United States was about 115,000,000 people; the population of the world was about 1,748,000,000 people. What per cent of the world's people live in the United States?

nation. The United States has many people — enough, indeed, to do her work. What per cent of the world's people are Americans? The map and the statistics of figure 4 will help you to answer the question.

3. What share of the world's iron does our country produce?

Are we wealthy in iron? Figure 5 provides facts of world production for one year which will help to answer that question. Remember that wealth in iron today means wealth in steel as well, for steel is made from iron. When iron is made into steel it becomes one of the most important materials of our new civilization.

Steel! How commonplace! We are surrounded by it on every side. We, who have grown up in this new civilization, feel toward steel much as we feel toward the lakes and clouds — it is just there. Steel? Why of course we must have it. Without steel what would we do for trains, automobiles, wagons, and delivery trucks? Cities could not exist without steel. If it were lacking, large apartment houses, great hotels and auditoriums, the street cars, the elevators in which you ride up and down in public buildings, — all these would be impossible. Our factories contain huge steel cranes. Our locomotives haul long trains of steel freight cars over steel rails. Our bridges are made of enormous steel beams. Most of our ships are made of steel plates. Steel is indispensable. Does the United States produce a large share of the world's pig iron?

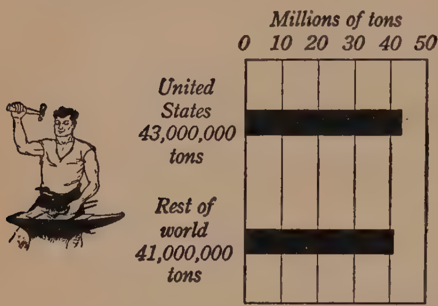

FIG. 5. What per cent of the world's pig iron does the United States produce?

4. Has the United States a large share of the world's power?

To manufacture such things as were just named requires tremendous amounts of *power*. After these things are made, some of them require power to make them useful. To run the thousands of trains that rush all over our country great quantities of power are required. In the United States there are 23,000,000 automobiles. Think of the power needed to drive all these cars! Scores of huge steamships enter our

FIG. 6. What per cent of the world's coal does the United States produce?

harbors, each propelled by engines that make great quantities of power. Steam, gas, and water produce great amounts of electricity to light our cities and to turn the wheels of our engines and machines.

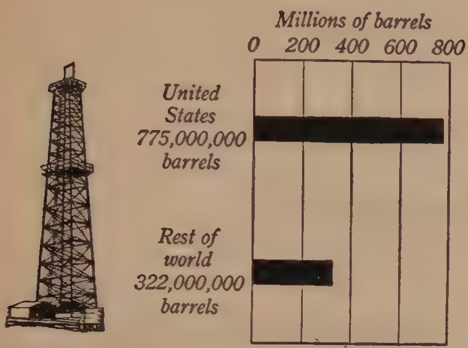

FIG. 7. What per cent of the world's oil does the United States produce?

Any country that leads in this age of machines must have great supplies of fuel with which to provide the power needed.

In this new civilization, what are our most important fuel resources? We burn coal and oil to make power. We use swiftly running water, which turns wheels to make power.

Has our country sufficient fuel within its own boundaries to produce enough power to do the work of the nation? In case enemies should block our ports and prevent us from trading with the rest of the world, would our trains stop running, our factories shut down, our farms go to waste, or could we keep running on our own power? Figures 6, 7, and 8 will help you to answer these questions. They only give you an idea of how much coal and oil we produce each year and of how much electricity we make every year by means of falling water. But they do not tell you the enormous quantities of power that we use every year. The later chapters of the book will enable you to give a much more complete answer.

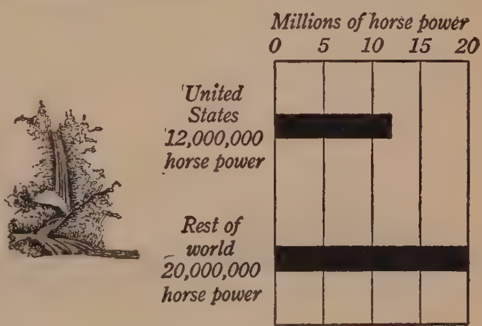

FIG. 8. Of all the hydroelectric power produced on the earth today, what per cent is produced by the United States?

5. How much of the world's transportation and communication does the United States own?

You have learned that the United States is a country of huge size, that it produces a large part of the world's steel, coal, oil, and water power. You will learn later how its population of more

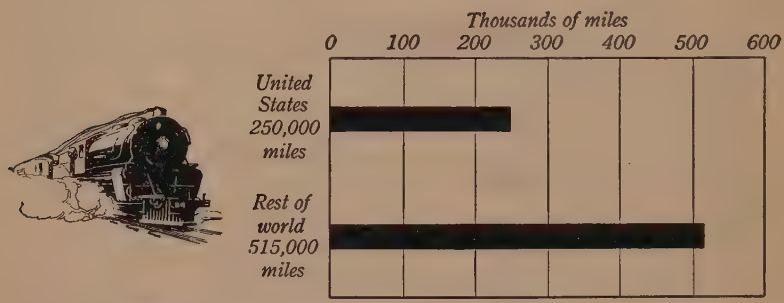

FIG. 9. What per cent of the railroad mileage of the world is in the United States?

than 115,000,000 people is scattered over its great territory in many thousands of communities. Our new civilization of steel and power must have efficient ways of transporting things and of sending messages rapidly. In the succeeding chapters of this book we shall learn how necessary it is that the people in one part of

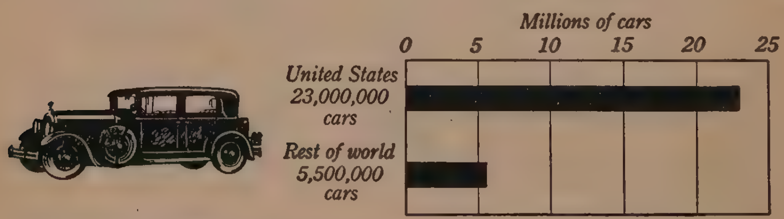

FIG. 10. What per cent has the United States of all the automobiles and trucks in the world?

the country can communicate easily with those in either near or far-distant parts. In order that the United States, in spite of its great size, shall continue to be one unified nation, its people must be tied together by many kinds of transportation and communication.

In the last 100 years the people of the United States cleared the wilderness, made the farms, dug the mines, and built the

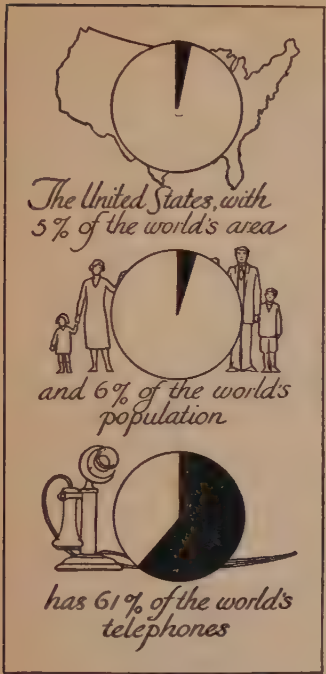

FIG. 11.

cities of our country. They also built great transportation and communication systems,—railroads, telegraphs, and telephones,—a fine national system of post offices, and a tremendous system of newspapers and magazines. These comprise a very important share of our wealth.

But at the same time that the United States was learning how to build railroads and to make great newspaper printing presses, England, France, Germany, and other countries were doing the same thing.

To help to find out whether Uncle Sam is "the rich man of the earth" we should answer another question; namely, How does the United States compare with the rest of the world in wealth of transportation and communication? Figures 9, 10, and 11 will help you to obtain a general answer to that question.

6. How much of the world's clothing materials does the United States supply?

In this new civilization the chief materials from which clothing is made are cotton, wool, silk, and leather. What would our people do for dresses, suits, shirts, underclothing, handkerchiefs, and stockings if they had no cotton, wool, or silk? What would they wear upon their feet were it not for leather? In the United States there are 115,000,000 people who have to be clothed. The bulk of their clothing must be

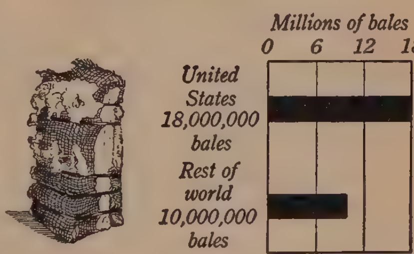

FIG. 12. What per cent of the world's cotton is produced in the United States?

made from these materials. Because it is cheaper than wool or silk, cotton is the most important single material from which clothing is made.

Does the United States produce a large share of the world's cotton? The facts concerning our production of this important raw material are presented in figure 12. What is your answer to the question.[1]

7. Uncle Sam's loaf of bread

The age of machines, the age of steel, the age of power, has produced great cities. How can they be supplied with bread and other necessary foods?

FIG. 13. What per cent of the world's wheat is raised in the United States?

Nearly half the people of the United States live in cities. Few of these people have anything to do with raising of foodstuffs. Although the United States is a country of great cities, it is also a country of many farms. Only about one fourth of all our people, however, actually work on farms. The others work in many other ways — at machines, in stores, running trains, or buying and selling things. In other chapters of this book we shall learn that Uncle Sam is not only a farmer but that he is a "machine" farmer; that is to say, in place of the wooden plows and the harrows, which were drawn by *muscles*, he has learned how to use machines which do the same work but much more rapidly.

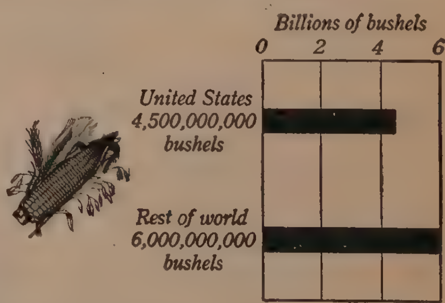

FIG. 14. What per cent of cereals other than wheat is produced in the United States?

[1] Problem II of the Workbook suggests that you study similar questions with respect to the production of wool, silk, leather, flax, and other materials.

Figure 11 shows that the United States possesses only about 5 per cent of the earth's area and about 6 per cent of the world's population. What do figures 13 and 14 show concerning the proportion of wheat and other cereals which our country produces? Is it a smaller or larger proportion of the world's production than would be expected from our area and our population?

8. How much of the world's paper is made in the United States?

Would it be easy to get along in these days without paper? Could we keep school without paper? Yes, we probably *could.* Our great-grandfathers who went to the "little red schoolhouses"

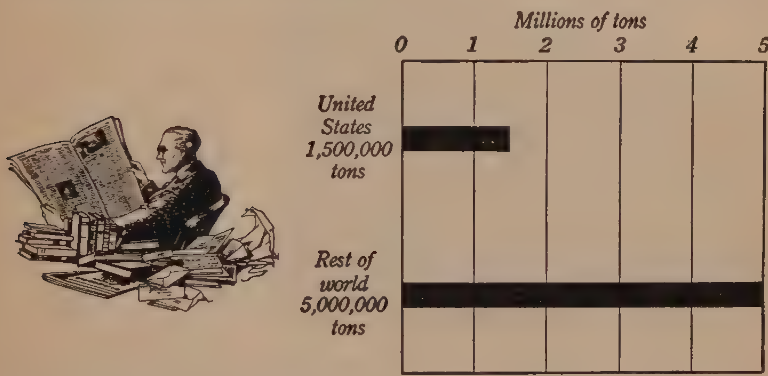

FIG. 15. What per cent of the world's newsprint paper does the United States produce?

had almost no paper. They did their writing on slates. But we today have much better schools, and we have large quantities of paper on which to write.

Could we run the government offices in our cities and states and in Washington, D.C., without paper? What would happen to all the jobs of buying and selling goods without paper? Could we carry on the work of business offices without it? What about the daily news? Would it not be more difficult for us to get our information about current events if we had no paper? Is the question of our paper supply, therefore, important?

From the reading matter under the picture in figure 15, what do you think is the answer to the question? What per cent of the

world's newsprint paper does the United States make? Remember that newsprint paper is only one of the many kinds of paper which the United States manufactures in great quantities.

9. What share of the world's wood supply is produced in the United States?

Paper is made from many things, — old rags, esparto grass, and straw, — but by far the greatest part of the paper of the United States is made from wood. Are you astonished to learn that it is the forests of the United States that produce most of the paper that we use in everyday life? Every time you read the newspaper you are probably making use of part of a forest.

Fig. 16. The United States cut 2,877,500,000 cubic feet of timber the year that the rest of the world produced 23,238,500,000 cubic feet of timber. What per cent of the world's wood does the United States produce?

Of course, all the trees we cut down are not made into paper. Much of the timber is used for building houses, for furniture, telephone and telegraph poles, railroad ties, ships, and many other things which we use in our daily lives. Even some kinds of cloth are now made from it; for example, artificial silk, called rayon, is being produced by treating wood. One hundred years ago nearly everything now made of steel was made of wood, and wood was generally used instead of coal for purposes of heating and cooking; but in spite of this, the amount of wood we use today is greater than ever before.

Figure 16 supplies the facts from which you can answer the question What per cent of the world's wood supply is produced in the United States?

10. Another way of describing the wealth of the United States: how many dollars' worth of things do we own?

Evidently Uncle Sam is a rich man whether or not he's *the* rich man of the earth. He owns great quantities of such resources as land, coal, iron, and oil; he produces large amounts of manufactured goods — railroads, telephones and telegraphs, paper, cotton cloth, lumber, etc. As we have seen, his natural resources are large and he uses them to manufacture many articles.

Fig. 17. How the dollars have piled up in seventy years in the United States! In 1850 the national wealth of the United States was estimated to be $7,136,000,000. In 1922 our wealth was estimated at $353,000,000,000

Are there other ways to describe his wealth? Yes. We can picture it in dollars and cents. The land and other natural resources, the manufactured goods, the factories, stores, mines, and farms, the railroads, telegraphs and telephones, and the buildings used for business purposes, government, and residence are wealth. All of them can be described in dollars and cents.

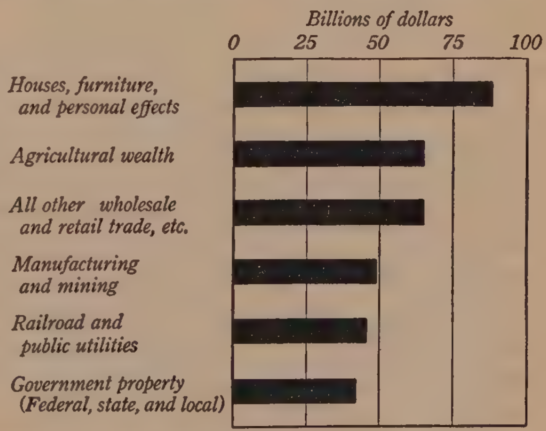

Fig. 18. Uncle Sam's wealth: houses, farms, stores, factories, mines, railroads, public utilities, government property

Figures 17 and 18 sum up the wealth of our nation in two different ways. $353,000,000,000! Three hundred and fifty-three billion dollars! Certainly that is an immense amount of money. From figure 17 can you estimate about how many times wealthier we are today than we were in 1850?

It is hard to think in terms of billions of dollars. Only a few

years ago it was hard to think in millions. Indeed, just before the World War the people of the United States were startled because it was costing about $1,000,000,000 a year to run the government of the country. At that time a $1,000,000,000 was so large that no one really understood its meaning. But today our national wealth is growing at the rate of nearly $13,000,000,000 a year, and our government spends nearly $4,000,000,000 a year. Hence it is important that all thinking citizens of the United States understand what these figures really mean.

At the time that the estimated wealth of the United States was $353,000,000,000, the estimated population of the country was 110,000,000. If you divide the wealth by the population, you will obtain the average wealth per person in the United States:

$$\frac{\$353,000,000,000}{110,000,000} = \text{approximately } \$3200.$$

That is, if the wealth of the United States could be divided equally among all the people of the United States, each person would have property and savings worth about $3200. Most of us live in families. The usual family consists of a father, a mother, and two or three children. If it were possible to divide the wealth of the United States equally among all the people, each average family would be worth about $13,000; that is, it could have a small house and be supplied with necessities and a few luxuries.

Of course the wealth of the United States is not divided equally, and could not be divided equally, among the people. A great proportion of it, as is shown in figure 18, is in factories, railroads, and business blocks, owned by associations and corporations. Indeed, two thirds of all the wealth of the United States is in government property, in railroads, in light, heat, and power companies, in large-scale manufacturing and mining corporations, and in wholesale and retail business concerns. The rest of our wealth lies in the houses we live in, our furniture, our clothes, and our farms and their produce.

The foregoing illustrations suggest that the United States produces so much of the world's goods that she is independent.

Does our Wealthy Nation produce Everything it Needs?

You would say, if you looked no further for facts, that the United States has within her borders all the food, coal, iron, wood, cotton — indeed, practically everything — that she needs to give her people a safe and comfortable life. Is this really true, however? Suppose you went to the front door some morning, picked up the newspaper, and read the following item:

England, France, Germany, and Japan Refuse to Trade With the United States

NO PRODUCTS OF OTHER COUNTRIES COMING TO AMERICAN PORTS

Experts Warn That No Foreign Products Can Reach America For Many Months

History has repeated itself. What happened to the American people in 1807 has happened again — no foreign goods are coming to American ports. For the first time in over 100 years we are cut off from other countries. Neither our ships nor those sailing under foreign flags will bring us the products of other lands. The United States must depend upon herself, at least for a while, — no one can predict for how long. The President has called special meetings of his Cabinet. Business and labor leaders are hurrying to Washington to take stock of the resources of the nation and to find out the best way of handling them.

Can the American people exist without supplies from other nations? That is the question now facing the United States. Can we raise enough wheat, corn, and cattle to meet our needs? Can flour be made to feed 115,000,000 people? Can meat be packed and distributed to all parts of the country? Have we enough fuel in our mines and forests to keep our railroads going and our mills running? Can our iron mines and steel mills continue to run night and day as usual, or must they be closed down part of the time? Will there be less building, and will cotton and woolen manufacturing plants close their doors? Will millions of our men and women workers be thrown out of employment? These are questions that the American people are now forced to answer.

Perhaps it seems absurd to think that a great world-trading nation like the United States could be cut off entirely from other countries. In the World War, however, Great Britain, France, Russia, Italy, and the United States threw a blockade around Germany and Austria, so that for many months it was impossible for those countries to bring in either raw materials or manu-

factured goods. Germany and Austria had to depend entirely upon themselves to feed and care for their population of more than 100,000,000 people. The strain was terrific. First, the people's luxuries disappeared; then, after a few more months, their comforts; and then they began to starve. When the war closed, thousands had died. So you see it is not impossible that a great industrial country may find itself forced to depend entirely upon its own resources.

If the United States could bring in nothing from the outside world, would it be able to carry on business as usual? Can you think of things for which we depend absolutely on other parts of the world?

What, for example, about rubber?

What per cent of the world's rubber is produced in the United States?

Can you imagine what life would be without rubber? Would automobiles run without it? Figure 10 shows the number of automobiles and trucks in the United States. The United States rides on rubber. Suppose the hundreds of ships that now bring rubber into our ports each year were unable to enter. How long would our automobiles continue to run? A year? In order to answer that question think how many miles good cord automobile tires will run. Perhaps 10,000; with luck, maybe 15,000 or more. And then when they were worn out, what would happen? New tires would be needed, of course. We know of no material other than rubber that we can use to make tires. Lacking rubber, automobiles would have to run on metal tires, such as were used on wagons and coaches before the days of the pneumatic tire.

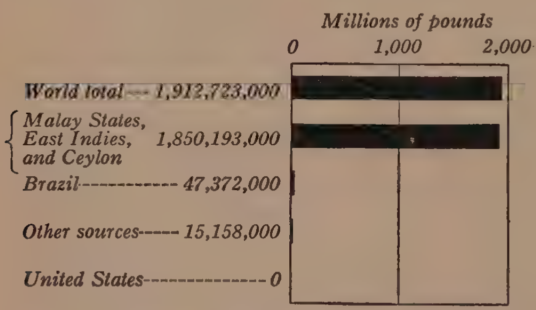

FIG. 19. What per cent of the world's rubber is produced in the United States?

What about the need for rubber to make other things that we use every day — the rubber in the telephone, in garden hose, in machines, in air-brake hose on trains?

Who produces the world's rubber? The facts given in figure 19 will help you to answer that question. More than 99 per cent of all the rubber of the world is produced either in the Orient or in Brazil. Hardly a pound is raised in the United States.

On the other hand, who *uses* the world's rubber? (See figure 20.) The United States uses almost three fifths of it; yet she produces practically no rubber at all! What do you think now? Could the United States live in the way that she does today if she were cut off from other parts of the world? What important changes would she have to make in her ways of living?

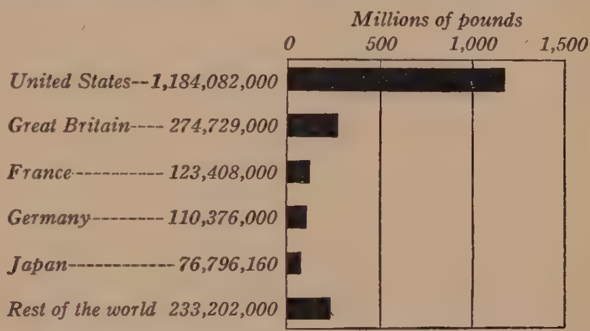

FIG. 20. What per cent of the rubber used in the entire world is consumed in the United States?

In this chapter we have tried to get a general understanding of the great resources of the United States. We referred to rubber merely to remind you that although the United States is rich and her people live fairly comfortably, she is unable to produce everything she needs. In other chapters of this book we shall discuss this important problem. We must not take the time now to consider fully the question of whether the United States could live by herself. You will learn later that, rich as she is, she is very dependent upon the other parts of the earth for many essential things.

What do you think now? Is Uncle Sam "the rich man of the earth"?[1]

[1] We intentionally omit in this chapter and in many others summaries of the main points considered. Teachers and pupils will find helpful summary exercises provided in the Workbook at appropriate points in the course.

INTERESTING READINGS FROM WHICH YOU CAN GET ADDITIONAL INFORMATION

Book

*Marshall, Leon C. The Story of Human Progress. The Macmillan Company, New York, 1925.

Chapter VI (Harnessing Nature and Living Together Well) is a fairly complete account of the great wealth of the American people. Many illustrations are included.

Magazine Articles

*"How Uncle Sam Leads his Cousins," *Literary Digest*, February 25, 1928, pp. 22–24.
"Our Incomes Doubled in Twenty Years," *Literary Digest*, March 5, 1927, p. 12.

UNIT II

THE CHIEF FACTORS IN THE HIGH STANDARD OF LIVING OF THE UNITED STATES

THE CHIEF FACTORS IN THE HIGH STANDARD OF LIVING OF THE UNITED STATES

I. Location in a Stimulating Climate

We live in the temperate zone, which has a pleasant and stimulating climate favorable to hard work and to producing fine crops.

II. Huge Size and Varied Resources

Our territory is vast, and contains broad farming lands and rich stores of coal, oil, and other sources of power, of iron, copper, and other raw materials necessary in an industrial country.

III. Many People Ready to Work

Our numbers are great and composed of many races and nationalities interested in and prepared to do varied kinds of work.

IV. Scientific Knowledge

Our history is one of hard work and inventiveness. By studying nature and thinking out our problems in a scientific way we, like the European people, have been able to invent extraordinary machines and to devise new ways of carrying on business.

In Chapters I and II we illustrated the fact that the people of the United States have many comforts. Compared with the people of a hundred years ago, they have a high standard of living. Furthermore, their wealth in natural resources and manufactured goods is great compared with that of other countries. In the remaining chapters of this book we shall study the chief factors that have made possible this high standard of living.

At this point it would be well to scan Chapters III, IV, and V, noting the manner in which the first three of these causes are considered. Note, for example, that Chapter III discusses the location of the United States in a stimulating climate. Chapter IV considers the great territory of the country, and shows you that our varied kinds of land have given us varied resources. Some of these resources will be discussed in later chapters of the book. Chapter V takes up our large and varied population. Note, furthermore, that the use of science is discussed many times in the remaining chapters; for example, in Chapters VI–X is the story of how men invented engines and used power to run them; in Chapter XII, the story of the invention of machines.

CHAPTER III

WHAT HAS THE LOCATION OF THE UNITED STATES TO DO WITH ITS PHYSICAL COMFORT?

It is a cool, sunny morning in late autumn. You get up feeling lively, energetic, hungry for breakfast, in a hurry to be outdoors, to be doing something. You feel cheerful, ready for anything. You whistle or sing. You walk down the street, and the soles of your shoes seem to bounce along under you. The air feels crisp, and you take a deep breath that tingles in your chest. The sun warms your back, but the wind in your face keeps you walking fast. A good day to play football, bright and snappy. It's great to be living!

We sometimes use a word which is peculiarly American to name this feeling of healthy activity. We call it "pep." We can find better words for that high-spirited, energetic feeling that is essentially American, but "pep" does well enough for everyday use.

Americans are known the world over as energetic people. And most Americans *are* energetic. Why is this? You would be right if you answered: "Partly because of the location of the United States on the earth." The fact that the United States happens to be located in one of the two *temperate zones* of the earth has more to do with our being an energetic, active people than anything else in the world. So important is this fact that this whole chapter will be devoted to it.

Our pep, our energy, is one of the greatest causes of our wealth, and of our comfortable standard of living. It helps to explain why we produce not only the most coal, oil, iron, wheat, and corn in the world, but also the most automobiles, soap, hats, shoes, bathtubs, and motion-picture films.

Now what is the temperate zone? In the first place, there are two temperate zones, one north and the other south of the equator, each of which extends from 23½° to 66½° latitude. We are only

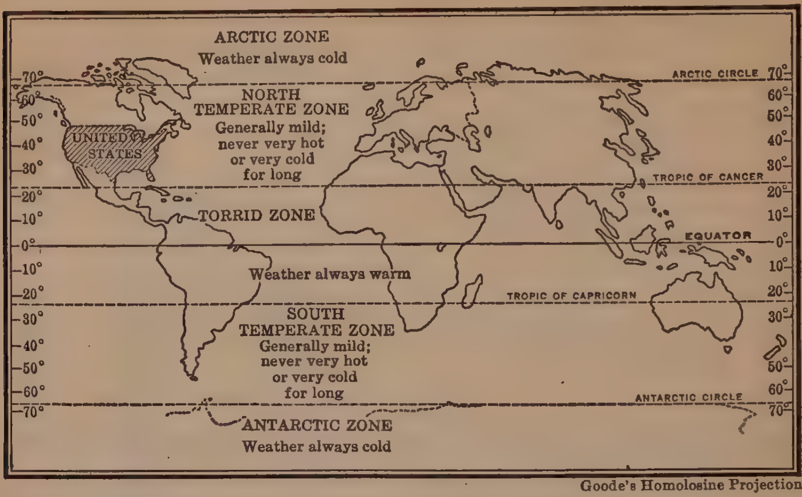

FIG. 21. This map shows that the United States is located in the north temperate zone. In the temperate zones the weather is never *very* hot or *very* cold for long periods. The climate is stimulating because the weather changes from day to day, so that people have much energy. What has the location of the United States to do with the physical comfort of its people?

concerned with the north temperate zone, for it is in this zone that the United States lies. In most parts of the temperate zones three things are true:

1. *Rain falls in moderate amounts* in all the seasons of the year.

2. *The seasons are strongly pronounced,* winter being clearly different from spring, spring from summer, and autumn and summer from each of the others.

3. *The temperature changes every few days.* Some days in winter are cool, others very cold. Some summer days are warm and others very hot.

An example of changes in temperature in the United States

A description of a week in early spring in northern United States illustrates the rapid changes that take place in the temperate zone.

Take a week in early April as an example. On the first day there is frost in the morning, but a warm sun in a brilliant blue sky raises the thermometer to above 50° at noon, and people begin to talk of their gardens. That night there is no hint of frost even in the coolest valleys. The

next day a dry wind blows from the south; the temperature reaches 70° by noon; the robins chirp on the lawn; the buds on the lilacs swell visibly, and people wish they had put on their summer clothes. The third day the wind has shifted to the southeast, the air though still warm is soft with moisture and feels much pleasanter than the day before. All day clouds come and go, the beautiful billowy clouds of spring. Several times little showers fall, but after a few minutes the sun comes out again. People say to one another, "April showers bring May flowers." In the afternoon a warm rain begins, but by morning the wind has shifted to the east and the air is cooler. Then toward evening a violent gale blows from the north, the thermometer drops 5° an hour, and the ground is covered with snow to a depth of an inch or two. That night the clouds disappear before a strong northwest wind, the stars shine like twinkling points in a sky of crystal, and it seems as if winter had returned. Yet the next morning the air is bracing rather than cold; the lilac buds are larger than ever, and when the warm sun melts the snow the grass appears surprisingly green. And so the weather comes back to where it started. Within five days *the temperature has varied from almost arctic to almost tropical*; the humidity has ranged from that of deserts to that of mid-ocean; and the wind has changed.[1]

How the Temperature affects People

The climate in the temperate zone is stimulating. In the regions called the tropics, except in the mountains, the temperature is nearly always warm or hot; it is never cold. In the arctic regions it is nearly always cool or cold, seldom warm. But in the temperate zones it is changeable—sometimes hot, sometimes cold. Study the map of figure 21. Note that most of the United States lies in the north temperate zone between latitudes 30° and 50°. Whether you live in Massachusetts or Oregon, in Minnesota or Maryland, or even as far south

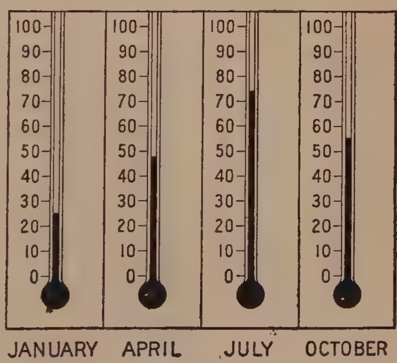

Fig. 22. The average temperature for Chicago during four months in 1926

[1] Reprinted, by permission, from *The Principles of Human Geography*, by Ellsworth Huntington and S. W. Cushing, published by John Wiley & Sons, Inc., New York.

as Oklahoma or Tennessee, you live in a region in which the weather is changeable. This fact is one of the most important reasons for our high standard of living.

Is the temperature in your town the same at noon day after day, week after week, the year round — in January, April, July, and October? No, probably far from it. The thermometer on your front porch or outside your window will show a different temperature at noon from week to week, and even from day to day.

The graphs of figures 22 and 23 are very convincing, are they not, of the changeableness of the temperature in our northern

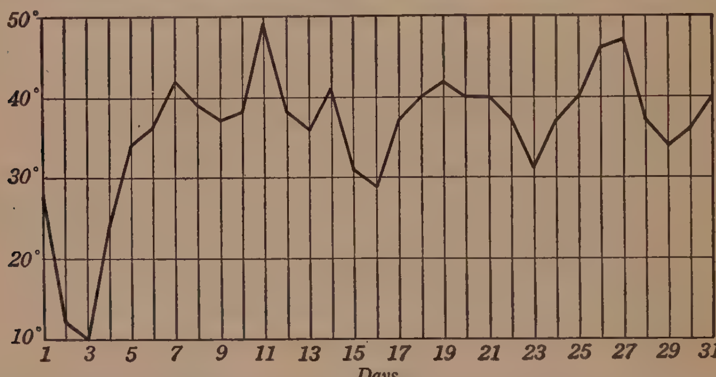

FIG. 23. Notice the way in which the temperature in New York City changed from day to day in one month in spring. Does this help to explain America's stimulating climate?

sections? You might make a record of the temperature at the same hour each day for a month in your own town to see if this is not so.

Examples of the effect of climate on the way people live in the hot tropical regions

If you lived in Porto Rico, in the Panama Canal Zone, in the Philippine Islands, or in central Africa, and made a graph like that given in figure 23, you would obtain a very different record. In 1925 the writer of this book and some friends worked for five months in the Philippine Islands. These islands are located in the tropics from about 4° latitude to about 21° latitude north of the equator. Day after day throughout those months the tem-

perature hovered between 80° and 90°. Sometimes it rose as high as 93° or 95°. In January the sun beat down upon us with about the same intensity as in May.

Now this had a very important effect upon our work and upon the way we felt. After a few weeks of hurrying about, as we had been used to doing in the cool climate of the northern United States, we began to feel listless and tired. We began to walk more slowly and to work less hard. We perspired constantly; the days were exceedingly monotonous, uncomfortable, and wearing. Then we began to understand why people who live in such regions sleep at noon, why the shops are closed for two or three hours in the middle of the day, and why the inhabitants of the tropics live in so leisurely a way. We saw that the energy of people depends very, very much upon the climate in which they live and hence upon their location upon the earth.

FIG. 24. Most of the people of Ontario and also of the Bahama Islands are of British ancestry. Nevertheless, life in the two regions is thoroughly different. What has position on the earth's surface to do with it?

Consider another example of the influence of climate on ways of living — the contrast between life in the Bahama Islands and in Ontario, Canada. Although these places lie more than a thousand miles apart, they were both settled more than 200 years ago by people from Great Britain. So far as we can discover the British people who went to live in these two regions had about the same physical energy. In Great Britain their ways of living were much the same.

Today, after 200 years, however, their descendants live in ways that are very different. In Ontario the people are unusually active. They work hard. They have well-kept towns and cities, many industries, and many other kinds of business. They have an excellent educational system. In the Bahamas, on the other

hand, there are few well-arranged towns and cities and not much industry and business. Large numbers of the people have never gone to school at all. Many others who learned to read and write in childhood have long since forgotten how. They rarely try to read; they rarely want to write. They like to sit and rest.

FIG. 25. A group of workers leaving a factory situated in a stimulating northern climate. Note the contrast between the energetic look of these people and the look of people in the tropics shown in figure 26. (Photograph from Ewing Galloway)

Why are there such differences in the ways of living of these two groups of English-speaking people? There are several reasons, of course, but one is far more important than the others. That is the difference in climate. Note on the map of figure 24 that the Bahama Islands are partly in the tropics. They lie off the coast of Florida below 30° north latitude close to the torrid zone. Ontario is more than a thousand miles north of the Bahamas, between 42° and 55° north latitude. Ontario has a climate very similar to that of our northern states. It is a stimulating climate with changing seasons and constantly varying temperature. In the Bahamas, on the contrary, the weather is perpetually warm and monotonous; a steady heat prevails, averaging about 80°. In consequence the

British people who live in the Bahama Islands are decidedly lacking in energy. This shows itself in the civilization which they have made there.[1]

The contrast between life in the tropics the world over, — in the Philippines, throughout the South Sea Islands and Central

FIG. 26. This figure shows a group of workers in a hot tropical country like the Bahamas. Here the climate reduces the energy of the people. Contrast this picture with figure 25. (Photograph from Ewing Galloway)

America, in Central Africa, — and life in the temperate zones is very well illustrated in the photographs of figures 25 and 26.

How Humidity affects People

People who live in the hot regions of Arizona and New Mexico say that they do not mind the heat "because it is so dry." People who live in southern Canada or northern New England, on the other hand, do not complain about the cold in winter because, they also say, "it is so dry." Some humorist told the story in which an

[1] This comparison of life in the Bahama Islands and in Ontario, Canada, was adapted from Huntington and Cushing's treatment of it in their excellent book, *The Principles of Human Geography* (John Wiley & Sons, Inc., New York).

inhabitant of New Mexico, one of northern New Hampshire, and one of the Panama Canal Zone were discussing the weather in their respective regions. The man from New Mexico said that the people there did not mind the heat because "it was such a dry heat." The New Hampshire man said that the people in New Hampshire did not mind the cold in winter because "it was such a dry cold." The visitor from the Canal Zone told of the months of continuous rain and then remarked that the people in the Canal Zone did not mind it much because "it was such a dry rain"!

The story reminds us that in speaking of the climate of the United States, we must consider *humidity*. By "humidity" we mean the amount of moisture in the atmosphere. At any given temperature the atmosphere can hold only a certain amount of moisture. When it holds all it can without raining, we say the humidity is 100 per cent. So 80 per cent humidity means that the atmosphere holds 80 per cent as much moisture as it can hold at a particular temperature. See if you can find out the average humidity in your town. For the cities of the United States in the spring or autumn the humidity ranges from about 52 per cent to 84 per cent.

There are, therefore, three weather conditions which determine the health and energy of a people. They are the temperature, the humidity, and the changeableness.

You know already that where we live the weather is *changeable*. Students of these problems have reached the conclusion that the most favorable temperature for a healthy and vigorous life among the white race as a whole is an average of about 64° for day and night together. People seem to be able to work and play and sleep best when the thermometer drops to about 55° to 60° at night, and rises not much above 70° or 72° in the middle of the day. Scientists have also reached the conclusion that the most favorable humidity, when the temperature averages about 64°, is 80 per cent both for day and night. (Look up the average temperature and humidity for various cities of the United States.)

Do you begin to understand why the location of the United States is one very important cause of her fine way of living? The fact that we live in the temperate zone, where seasons

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FIG. 27. This relief map of the United States shows the "lay of the land": the mountain ranges, hills, plains, and great river systems

change, where the temperature is neither uniformly hot nor uniformly cold, but is constantly changing, profoundly affects the life of the country.

What causes the Variable Weather of the Temperate Zone?

No doubt you are wondering why the temperate zone has such changeable weather. Why do the temperature and the humidity vary? One of the chief causes is the winds which bring the rain clouds and blow them away again, and which help to regulate the temperature. Most of the winds that play over the northern part of the United States are "westerly"; that is, they come from the west, most of them moving north and east. The winds that pass over North America have come over the warm currents of the Pacific; so they are warm and moist. After blowing across the Pacific coast of North America they come in contact with high mountains — first the Coast Range, and then the higher peaks of the Sierra Nevada and the Cascades; they finally reach the Rockies. To cross the first ranges of mountains the winds have to rise. As they rise the air expands and becomes colder. This causes the moisture in the winds to condense in little drops which fall to the earth as rain. If the temperature at the higher altitude is below 32° F. the water vapor may freeze and fall as snow. Hence the land along our northern Pacific coast and the western slopes of these mountains is well watered. The rainfall map (figure 28) shows that 60 inches of rain falls there each year. The soil there is fertile and so it produces fine crops.

After the winds have passed over the first two mountain ranges, dropping most of their moisture on the way, they sink nearer to the earth again. They become warmer, and therefore as they blow across the plateau region immediately east of the Sierra Nevada and of the Cascade Range they are apt to gather up moisture from the earth instead of causing rainfall. So this region is very dry, averaging less than 20 inches of rainfall a year. The land in the southern part is almost desert because the winds are continuously taking up moisture as they pass over. Less than 10 inches of rain falls in a year.

The same thing happens when the winds pass eastward over the Rocky Mountains. They have gathered the moisture from the land between the Cascades and the Sierra Nevada, and the Rockies. (Notice on figure 27 the great distance between these ranges of mountains.) The winds rise and the moisture in them condenses and falls as rain or snow. Figure 28 shows you that on these slopes fall 20 to 40 inches of rain a year. On the eastern side

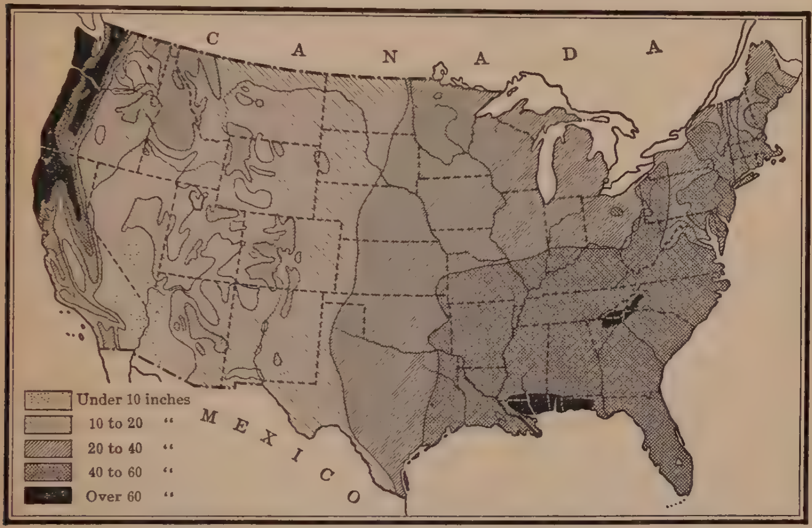


FIG. 28. The map shows the average number of inches of rainfall in a year in different sections of the United States. The dotted regions on the map have less than 10 inches; those shown in black have more than 60 inches. This great difference in the amount of rainfall helps to give us a great variety of climate. Compare this map with the relief map, figure 27

of the Rockies the winds sink nearer the earth again. They have been drained dry, and as they pass over the great grazing plains they take up moisture instead of causing rainfall. Hence our great grazing plains have less than 20 inches of rainfall a year.

So these *prevailing westerly winds* move across our country, alternately dropping moisture in the form of rain or snow and taking moisture up again from the regions over which they pass.

We see, therefore, that these westerly winds blowing over our country help to give us changeable weather. We have already seen how this kind of climate helps to give us physical energy and makes it possible for our people to work steadily throughout the

year. But *this* is not the only way in which changeable weather adds to our welfare. Changes from hot to cold, and from sunshine to rain, are also good for many of our crops.

THE CHIEF FOODSTUFFS OF THE WORLD ARE RAISED IN THE TEMPERATE ZONE

Within our temperate zone are grown many of the chief cereals and other important foodstuffs of the world. If we list only those valued at over $1,000,000,000 (one billion dollars) a year we include the following products:

Wheat	Corn	Cattle
Potatoes	Oats	Rye
Dairy products	Swine	Barley

The United States grows some of each of these nine products and in the production of many of them she leads the world. Turn back to Chapter II and note her share in the growing of wheat, for example.

Most people living in the temperate zone depend upon wheat for their bread. In the United States we eat bread made of wheat perhaps three times a day. In almost any restaurant the waiter will ask you if you wish rolls or bread with your meal. In France fine wheat bread is the chief part of the meal for most people. So it is in many other countries in the temperate zone. Wheat is so nutritious that even if people had no other kinds of food, they could live for a long time on it alone. And wheat has another great advantage: it can be stored and kept for a long while without spoiling. Look at the wheat map of the world, figure 29. Where is the largest amount of wheat produced? In what countries? In what zone?

Corn is another important crop of the temperate zone. The corn belt is, as Professor J. Russell Smith says, "a gift of the gods — the rain god and the sun god. The rain god gives summer showers; the sun god gives summer heat. All this is a conspiracy to make man grow corn. Having corn, man feeds it to cattle and hogs and so becomes a producer of meat."

Look at the map of figure 30 and find the chief corn-producing countries. As you will learn in a later chapter, the United States

FIG. 29. Where the wheat of the world is raised

is the world's chief producer of corn. The American Indians cultivated corn before the white men came to the continent. They

FIG. 30. Where the corn of the world is raised

taught the settlers from Europe how to grow corn and how to prepare it for eating. They gave the settlers the seed from which to raise it. So corn is really one of America's great contributions to the foodstuffs of the temperate zone.

Another staple food which we see on our tables almost as frequently as we see bread is potatoes.

Potatoes are another product of America and of the American Indians. They also were grown in the region now covered by the United States before the people of other countries in the temperate zone knew anything about them. But today, as you can see on the map of figure 31, it is northwestern Europe and not the United States that is the chief grower of potatoes. Europe produces 90 per cent of the world's potato crop.

Temperature and rainfall and the changeable weather of the temperate zone combine, therefore, to favor the growing of these and

FIG. 31. Where the potatoes of the world are raised

many other crops. We shall see in a later chapter that the United States is divided into several agricultural regions, each of which is suited especially to certain crops. Indeed, there is very little land in the United States that cannot be used for some kind of agriculture.

SUMMARY

How, then, does the location of the United States affect its standard of living?

Now we are prepared to understand what is meant by saying that the favorable location of the United States on the earth is the first cause of our physical comfort. Our country is located in the temperate zone, where seasons differ sharply. The central and northeastern parts of the United States, where most of our

people live, are located where rain falls intermittently and where *changing* windstorms bring variable weather. These facts have two effects:

1. They produce a stimulating climate, which gives the people energy.

2. They help to produce the fine crops which are needed to feed a great nation.

Thus, to the one fact that it happens to be located just where it is on the surface of the globe, the United States owes much of its high standard of physical comfort.

INTERESTING READINGS FROM WHICH YOU CAN GET ADDITIONAL INFORMATION

Books

Bishop, A. L., and Keller, A. G. Industry and Trade. Ginn and Company, Boston, 1923.

Chapters I and II present a brief account of how natural factors have helped to bring about America's comfortable standard of living.

Maclean, J. Kennedy. Heroes of the Farthest North and Farthest South. Thomas Y. Crowell Company, New York, 1923.

An unusually good account of the unfavorable living conditions in arctic regions.

*Stefansson, Vilhjalmur. My Life with the Eskimos. The Macmillan Company, New York, 1926.

This is one of the best descriptions of the Eskimos' constant struggle for food, clothing, and shelter.

Wallace, Dillon. The Lure of the Labrador Wild. Fleming H. Revell Company, New York, 1908.

A dramatic account of an exploration trip into a land where during the winter season the temperature is far below freezing, making food extremely scarce.

Magazine Article

*"Canada from the Air," *National Geographic Magazine*, October, 1926, pp. 389–466.

CHAPTER IV

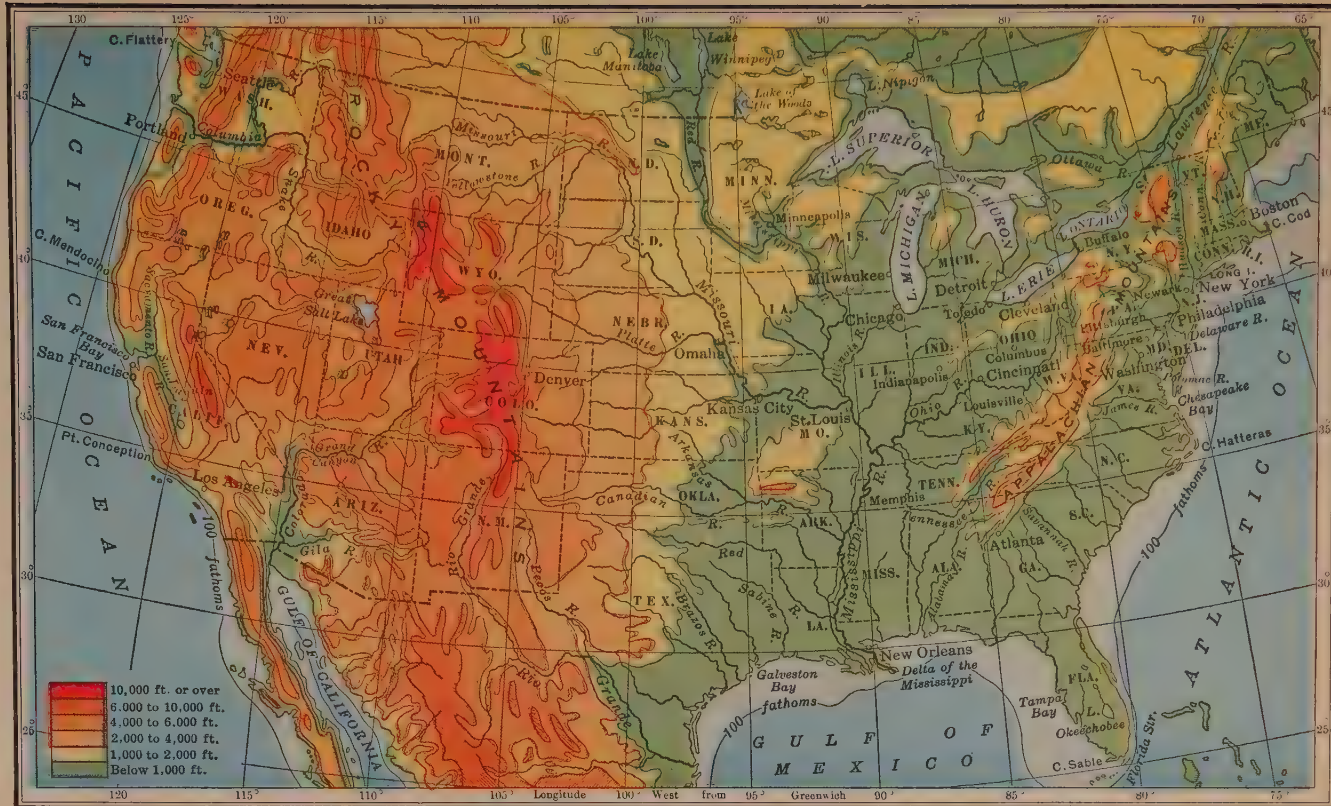
WHAT HAS THE SIZE OF THE UNITED STATES TO DO WITH ITS HIGH STANDARD OF LIVING?

How Large is the United States?

In this chapter we shall study the second factor that made possible the wealth and physical comfort of the people of the United States; namely, the great size of our country. In Chapter II we learned that although the United States is only one of scores of countries of the world, it covers about one twentieth of the earth's area. It is, indeed, nearly as large as all Europe. In figure 32 a shaded map of Europe has been drawn over an outline map of the United States. This shows how closely the areas of the two regions correspond. Our one country is nearly as large as all the countries of Europe!

Fig. 32. In this figure the area of Europe (shaded) is compared with that of the United States. How closely do they correspond? The areas in square miles can be found in the Appendix

It is difficult for us to comprehend the huge size of our country. Great distances mean little when one can talk by telephone with someone across the continent or see in the Boston morning papers pictures of what happened yesterday in San Francisco. We feel close to our fellow countrymen in all parts of the United States now that we can turn a dial on the radio and hear human voices in New Orleans, Minneapolis, Seattle, Washington, Portland, Maine, or in any of the large cities of our country.



This map shows the principal rivers, lakes, and mountains of the United States

Although it is difficult, nevertheless it is important for us to appreciate the vast extent of our country. There are several ways in which we can study the matter. One is by comparing the size of our country with that of others. Note the comparison presented in figure 33. It shows that this one of our 48 states, New Mexico, is larger than the four regions included in the British Isles — England, Scotland, Wales, and Ireland.

FIG. 33. Comparison of the size of the British Isles with New Mexico. New Mexico is only one of our 48 states. There are many that are larger and many that are smaller. The figure shows that New Mexico is larger than the British Isles

We obtain an increased understanding of the size of our country, furthermore, when we compare the sizes of some of the states which compose it. No more interesting example could be taken than that of the comparison of Texas, our largest State, with Rhode Island, our smallest. An interesting anecdote is told about a former president of the United States, Theodore Roosevelt, who was called as a witness in a trial. In the course of his testimony Roosevelt made some remarks about the size of the country. A lawyer, wishing to trip Roosevelt, asked, "Mr. Roosevelt, how many times larger than Rhode Island do you think the state of Texas is?" Without a moment's hesitation Mr. Roosevelt said, "Oh, about twenty times." A laugh greeted his reply. See if you can tell from figure 34 why the lawyers laughed. Are you surprised that they did?

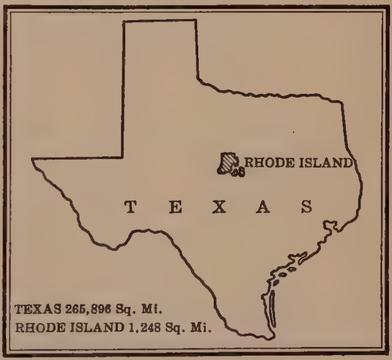


FIG. 34. Why did the lawyers laugh?

Some Stories that illustrate the Great Distances across our Country

It is difficult, however, to obtain a feeling for the size of our country by merely studying maps or comparing statistics. The best way would be to walk over the United States as our great-great-grandfathers did when they crossed the Appalachians and settled the prairies and the plains; when they climbed the Rockies to reach the farm lands of Oregon or the gold lands of California. It is the traveler who goes afoot or on horseback who really knows distance, not the man who goes to bed in a comfortable Pullman berth in New York some evening and wakes up the next morning in Pittsburgh on the other side of the Appalachians.

Travelers through the Appalachian Mountains a hundred years ago partly understood the size of the growing United States

Christopher Schultz, who traveled from New York to Pittsburgh in 1807, could really appreciate how great was the distance covered by the narrow eastern part of our country. It took him 23½ days to make the trip, which was not more than an eighth of the distance across the continent. As was usual in those days, he started up the Hudson River to Albany on the new Hudson River steamboat, at a very rapid pace. That part of the journey, which today we do by rail in three hours, took only a day and a half! Then by land eighteen miles in a lumbering coach on the turnpike to Schenectady — another day and a half. Then 104 miles in a small keel boat which slowly and laboriously made its way up the Mohawk River to Utica. (Today an airplane can make this part of the trip in an hour; it took Schultz five days.) Then three days on the Oswego River, and another three days in a lake sailing boat from Oswego to Lewiston. Then "by land" to Black Rock, if you could call it land, for it was a mud horse path where loads sank from sight and even horses drowned in watery pits. Broken-down wagons blocked the way for hours, and the weary travelers, with heavy wagons and baggage, struggled on to complete the bare seventeen miles in a day and a half. (Anybody now could do it in half an hour in an automobile!) Into a boat again at Black

Rock and a two-day sail across the lake to Presque Isle. A day over an "improved" turnpike to Le Bœuf on the Allegheny River and then, at last, an easy five days to complete the trip by boat, down the Allegheny River to Pittsburgh. A rapid journey! Only nine changes and made in less than a month!

Today the air mail makes the entire trip, by a straight air route, in *four hours*.

Even though he was able to ride most of the way from New York to Pittsburgh, no doubt Schultz had a vivid appreciation of the breadth of the narrow *eastern* part of our country. But he and others at that time had little understanding of the vast distances covered by that great *western* territory between the Mississippi River and the Pacific.

The pioneers who took the old California trail really appreciated the size of our country!

Look at the relief map of the United States, figure 27. From New York to Pittsburgh by a straight route is hardly an eighth of the way across our wide country. Compare that region with the western half of the continent.

On pages 52–56 there are a few extracts from a diary that was written by a pioneer who crossed the plains and went over three ranges of western mountains in 1849. Read these and feel as vividly as you can the sense of enormous distances covered by him and others of the courageous frontiersmen of that day. Many others traveled even farther than he did, but few of them kept diaries. In his record of the trip not only is the size of our country illustrated but also the constantly changing climate, the lay of the land, the kind of soil and vegetation. You will read how one week they rumbled smoothly over prairie trails; the next, how they dared the dangers of mountain passes. In May they nearly froze in icy mountain storms; in June they staggered along under a broiling desert sun. Nearly five months required to cross our country!

The diary certainly illustrates the great size of the United States and the astonishing differences between its various sections.

In Chapter V you will learn that two of the characteristics of the American people are courage and ambition. James Abbey,

who wrote the diary, had both these qualities. In 1849, when gold was discovered in California, he joined a group of people who were traveling west to seek their fortunes in the new gold country. By that time the frontier had crept as far west as St. Joseph, Missouri, but west of that town were miles and miles of unexplored land. The party left St. Joseph April 3, 1849. Through April the trip was fairly easy. There were a few unimportant accidents, as when wagons got sunk in the mud and everybody had to lend a hand to pull them out. For two or three weeks they managed to make from fifteen to twenty miles a day over fairly good roads. From here on let the diary tell the story.

April 30th . . . The day is cold and the wind is blowing so hard that it is almost impossible to stand up, but the boys say we are bound for California and it will never do to stop for wind, so we toddled on. Traveled today 15 miles over a good road.

Eighteen days passed in travel over fairly smooth prairie land.

May 18th . . . We traveled today some ten miles, came to a spring of pure cold water, which to a thirsty and weary traveler in this region nothing can be more luxurious, after traveling all day under the burning hot sun, with throats parched with heat and dust.

May 19th . . . We are still blessed with good health, mammoth appetites and getting on as finely as we could desire. . . . After breakfast I took a stroll some four miles from our camp. . . . I had rambled some distance from the roadside and came to a new-made grave. It was some poor fellow, and from appearances had not been made long. The wolves had been trying to dig it up. . . .

Five days later they encountered their first serious trouble.

May 24th . . . We traveled some three hours when we arrived at the head of Ash Hollow. We descended into it down a steep precipice, some seventy-five feet, where our wagons had to be let down with ropes.

They had two weeks more of slow-going travel before they reached a country where there was little drinking-water.

June 8th . . . The soil and water of the country through which we are now traveling are impregnated with alkali, salt, and sulphur, rendering water dangerous and unfit for use. I saw today sixteen skeletons of

cattle [belonging to earlier westward-bound travelers] that had died last year from drinking this alkaline water, all within two steps of one another.

June 11th . . . Troubled all last night with the jaw ache and this morning find my face swollen as big as a peck measure, but still able to do duty at breakfast. . . . It is astonishing how ox teams can travel. Their feet have been very sore, but traveling in the hot sand has greatly improved them.

June 12th . . . On our way by five o'clock. . . . After traveling about a mile up the bank of the river we came to another crossing, where we again had to ferry. Here we were compelled to carry all our things by hand a quarter of a mile over a cliff of rocks and through a pass barely large enough for one person to rub through. We took the running gears of our wagon all apart, and ferried them up the river on our bed [wagon bed] by means of a long rope stretching some distance up the river. . . . All of us pretty well tired out. . . . Traveled some five miles by moonlight to make up for lost time.

Ten days were passed in a hot, desert-like region.

June 22nd . . . We traveled sixteen miles today under a broiling sun and over a dusty road without finding a drop of water for our cattle. . . .

At last they approached the first range of mountains — the Rockies.

June 26th . . . Three o'clock brought us to the summit of a high ridge, the ascent of which is most beautiful. As we leave this summit the tug of war commences. We travel down sides of mountains which present the most gloomy aspect upon which a human being ever gazed. The road is an awful one. . . . Here the pass is so narrow and deep that the rays of the sun never penetrate to the bottom. . . . This creek we are compelled to cross thirteen different times. The road here is difficult almost beyond conception.

Two weeks later he wrote:

July 9th . . . We were brought up at the brow of a steep road on the spurs of the mountain, presenting a most dismal prospect for the passing of a wagon. We took all the cattle out of our wagon except three yoke, and, putting ropes across each side of the bed, all hands got on the upper side of the mountain [road] and held on like good fellows to prevent the wagon from upsetting in the creek, and in half an hour had all scaled the walls of the precipice without an accident.

In this region between the Rockies and the Sierra Nevada the severe night cold gave way to sweltering noon heat.

July 13th . . . The morning was disagreeably cold, the water in our buckets having frozen during the night to the thickness of a dime. . . . This has been the most fatiguing morning's march we have yet experienced. The road dusty and the sun pouring down on us with such intense heat as to cause the perspiration to roll off my face in large drops.

Fig. 35. Day after day, week after week, the pioneers laboriously made their way across the plains and huge mountains of our country. The frontiersman truly understood the great size of his country

July 21st . . . This is an awful-looking place; no grass; nothing growing but wild sage and a few small patches of prickly pear. Distance today eighteen miles over a sandy plain.

July 24th . . . The prospect before us begins to look brown. No grass this side of the Sink, and what may be left by the emigrants in advance of us is parched up by the sun; so we are fearful that we shall not get our teams through.

At last they entered the dreaded desert.

August 1st . . . The commencement of the sixty-five-mile desert.

August 2nd . . . Started out by four o'clock this morning; at six stopped to cook our breakfast and lighten our wagons by throwing away

the heavier portion of our clothing and such other articles as we can best spare. We pushed on today with as much speed as possible, determined, if possible, to get through the desert, but our cattle gave such evident signs of exhaustion that we were compelled to stop. Being completely out of water, myself, Rowley, and Woodfill bought two gallons from a trader (who had brought it along on speculation), for which we paid the very reasonable price of one dollar per gallon. The desert through which we are passing is strewed with dead cattle, mules, and horses. I counted in a distance of fifteen miles 350 dead horses, 280 oxen, and 120 mules,[1] and hundreds of others are left behind, being unable to keep up. Such is traveling through the desert. . . . A tanyard or slaughterhouse is a flower garden in comparison.

Nine days later they were out of the desert and beginning to ascend the second mountain barrier, the Sierra Nevada.

August 11th . . . Of all the rough roads I have ever seen or even imagined, this beats them. Rocks from the size of a flour barrel to that of a meeting-house are strewed all along the road, and these we are compelled to clamber and squeeze our way through as best we can. The boys say they never saw a road a hundredth part as bad as this. . . .

August 13th . . . On consultation last night it was determined to throw one of our wagons away and double team. . . . Commenced ascending the second summit of the mountain; traveled about half a mile, in which distance we had gone up about a hundred feet, when the cattle gave out and refused to stir an inch. This was a pretty predicament; a number of teams were below, waiting for us to go ahead before they could move. Everything was thrown into confusion. . . . It was finally concluded to pack our oxen with what little provisions and clothing we had and throw the wagon away. We went to work arranging things for packing; at twelve o'clock, having everything ready, rolled out. . . . We had traveled about an hour when our oxen became much wearied and badly frightened; one young fellow that had our cooking utensils aboard, such as dishes, knives and forks, cups, tin-pans, etc., etc., ran off down the mountain with his pack hanging to him, throwing everything helter-skelter in every direction.

Only two days later the summit had been crossed and they descended the western slopes of the Sierra Nevada into a warm grassy valley.

[1] An average of one dead animal for every 106 feet of road.

August 15th . . . Beautiful flowers, myrtles, etc. are frequently to be seen exhibiting all the freshness of May. . . . We are now fifty miles from the gold diggings. . . . Distance today fifteen miles.

August 17th . . . Last night was quite cold, and all the cover we had saved when our cattle refused to further pull our wagon was not sufficient to keep us warm. . . .

August 18th . . . Drove on till about ten o'clock, when our cattle appeared so nearly exhausted that we stopped and cut down the limbs of some oak trees to feed them. For ourselves we had cherries, plums, raspberries, gooseberries, and filberts, which the boys gathered while in camp here. . . .

Fig. 36. Through tremendous passes in the Rocky Mountains slowly crawled the prairie schooner

August 19th . . . This morning we started at six o'clock, and in two hours struck the gold valley. . . .

August 23d . . . The most I have made in one day in digging here [in the gold valley, their final destination] is four dollars, and I have done some tall digging. . . .[1]

No doubt you would have made the same exclamation as did the Forty-niners on arriving at the gold valley after more than four months of travel: "Some joke to give Columbus a place in history for discovering this country! A blind man couldn't miss it!"

[1] These extracts are from Dunbar's *History of Travel in America.* Copyrighted and published by the Bobbs-Merrill Company. Used by special permission.

THE UNITED STATES IS NOT ONLY LARGE IN AREA; IT ALSO INCLUDES MANY KINDS OF LAND AND NATURAL RESOURCES

Our great-grandfathers, therefore, had good cause to appreciate the vastness of the United States. They saw a continent stretching wide across the world, difficult to cross, sometimes hard to live upon.

But they did not know, as we do today, that its mountains, valleys, plains, and even its deserts, covered so many marvelous

FIG. 37. You can see from this picture the varied kinds of land contained in the United States; indeed, even in this short distance of twenty or twenty-five miles are tall, snow-clad mountains, forested and grassy hills, and a rich valley good for growing fine vegetables

resources. They knew the greatness of its forests and the fertility of its soil. They had heard stories of the rich gold in the sands of California. But they could merely guess at the vastness of its stores of iron and copper, the wealth of coal and oil below its farm land, and the tremendous power in its waterfalls and rivers.

Much of the land that seemed to them waste and barren is dotted today with fertile farms and flourishing cities. On the great central plains are miles of wheat like a green sea whose waves swish in the wind. Between the central plains and the two oceans that bound the continent are many and varied kinds of land.

There are mountains and forests. There are rolling hills and valleys dotted with farms and villages. There are lakes bordered by copper and iron mines. There are waterfalls beside which are factories and busy towns. There are white fields of cotton, bright patches of apple orchards, and orange groves. There are harbors, with black railroad paths leading to them and the tall cities on their shores.

Certainly the United States is vast in size. It is even more vast in the variety and richness of the territory which lies within its borders. Nature made it a large country. Nature provided a broad and rich continent, with a climate stimulating for people and productive of plants and animals. Nature provided layers of coal, oil, gold, iron, and copper in the land. Nature provided mountains where forests abound, and down whose sides powerful waterfalls plunge.

In the last chapter we noted that one of the chief factors that produce the wealth of the United States was its favorable location on the earth. In this chapter we have learned that the second great factor of our high standard of living is our vast territory and its wealth of natural resources. In the next chapter we shall learn something of the people who settled in this land of opportunity.

INTERESTING READINGS FROM WHICH YOU CAN GET ADDITIONAL INFORMATION

Book

PARKMAN, FRANCIS. The Oregon Trail. Ginn and Company, Boston, 1910.

An exciting story depicting the hardships of travel west of the Mississippi River and giving you an idea of the great size of the country.

Magazine Article

*"The Non-stop Flight across America," *National Geographic Magazine*, July, 1924, pp. 1–83.

CHAPTER V

THE UNITED STATES: THE HOME OF MANY NATIONALITIES AND RACES

What would our vast continent be worth if there were no people on it? What would our fine climate amount to if there were nobody to enjoy it, if nobody planted crops on it? Land becomes of value only when there are people to enjoy its beauty, to thrive upon its soil, and to use its resources. Because people are a most important form of a country's wealth, we must understand who the people are who call themselves "Americans."

There are only three countries with greater populations than that of the United States: China with approximately 400,000,000 people, India with approximately 325,000,000, and Russia with approximately 145,000,000. Our country stands fourth in number of people (105,000,000 in 1920), estimated at 115,000,000 in 1928.[1]

The United States is the Home of People from Many Nations

Our country is not only large in number of people, but it is also interesting in another respect; it is a country of immigrants. It has been peopled by men and women from every important country on earth. For three hundred years they have been coming here from Europe, and from Asia, Africa, South America, and the distant islands of the world. Most of them, however, have come from Europe.

They came for many reasons — desire for a better living, freedom to think and worship as they wished, ambition for more education, longing to be with relatives. Examples like the following could be multiplied. A German nurse girl gave the reason that was in the minds of many: "I heard how easy it was to earn

[1] Throughout this book we shall use 115,000,000 as the latest estimate of our population.

money in America." A Lithuanian boy came because he was told that in America you can have "life, liberty, and happiness. . . . You can read free papers and prayer books; you can have free

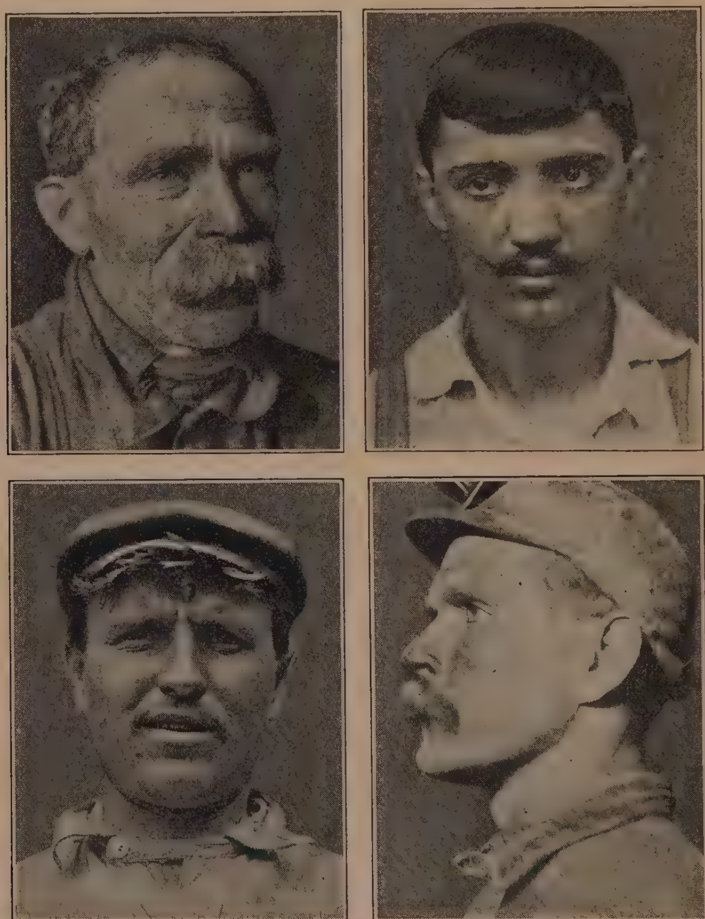


FIG. 38. These four men are now American citizens. They were born, however, in four different countries. Can you guess the countries? The correct names are given in the note on page 62

meetings and talk out what you think." A Czechoslovakian, waiting on table in a restaurant, gave as his reason for coming: "I wanted more education and I am going to one of the colleges." A big laborer known as Big Sam, a giant of a man from south-central Europe, came some years ago. He worked hard for long

hours at heavy work; from his small pay he saved money and brought his relatives over here too. "Now," he says, "you will not find a man of our group left in my native village; that is, from the age of eighteen to fifty; they are all in America."[1]

By the millions they have come from the older countries to make their homes in America. English, Scotch, Irish, Scandinavians, Germans, Russians, Italians — people of almost every country — have become Americans and call the United States home.

In the United States Everyone's Ancestors were once Immigrants

Every person in the United States today (except the few remaining Indians) is either an immigrant or the descendant of an immigrant. The first coming of the immigrant ancestors may have been as long ago as 1620, when the Pilgrims came; or it may have been in 1850, when Germans helped settle the farms of the Middle West, or even after 1900, when the Slavs came. But regardless of when it occurred, almost every American today traces his ancestors to a homeland far away. Most of these ancestors lived in Europe, but the descendants are Americans just the same.

Not only were everyone's ancestors immigrants, but Americans today are of mixed parentage. Italian marries Irish, Slav marries Greek, English marries French, and all intermarry with "Americans." As a result, you frequently hear people say: "I am part French and part Italian"; "I have Irish, German, and English blood in me"; "My mother was Slavic and my father was Greek." Such mixtures are characteristic of hundreds of thousands of families in this country today.

The table of figure 39 on page 62 shows the nationalities represented in the family of one "American," James Fitch. It is a good illustration of the mixed parentage of many Americans.

James Fitch's eight great-grandparents were of eight different nationalities! Nevertheless, his descendants are very proud of the fact that they are "Americans." James Fitch was merely one of thousands of sturdy American pioneers.

[1] Adapted from Peter Robert's *New Immigration* (The Macmillan Company, New York, 1920), p. 12.

James Fitch

Father: Daniel Fitch — Father's side
- Grandfather: Robert Fitch
  - Great-grandfather: Scotch
  - Great-grandmother: Irish
- Grandmother: Mary (Jones) Fitch
  - Great-grandfather: French
  - Great-grandmother: Spanish

Mother: Mary (Ransom) Fitch — Mother's side
- Grandfather: Sewall Ransom
  - Great-grandfather: Slavic
  - Great-grandmother: German
- Grandmother: Lucy (Brown) Ransom
  - Great-grandfather: Dutch
  - Great-grandmother: English

FIG. 39. Genealogical table showing the nationalities of the eight great-grandparents of one "American"

But James Fitch and his parents were born in this country. Today there are living in the United States approximately 15,000,000 people who were *not* born in this country. Figure 40 shows the countries which have contributed the greater number. They were born in Great Britain, France, Germany, Italy, Russia, Poland, Canada, Ireland, and in many other countries. Yet these foreign-born people all want to be known as Americans.

NOTE. The home countries of the four men in figure 38 are upper left, Austria; upper right, Serbia; lower left, Russia; lower right, Wales.

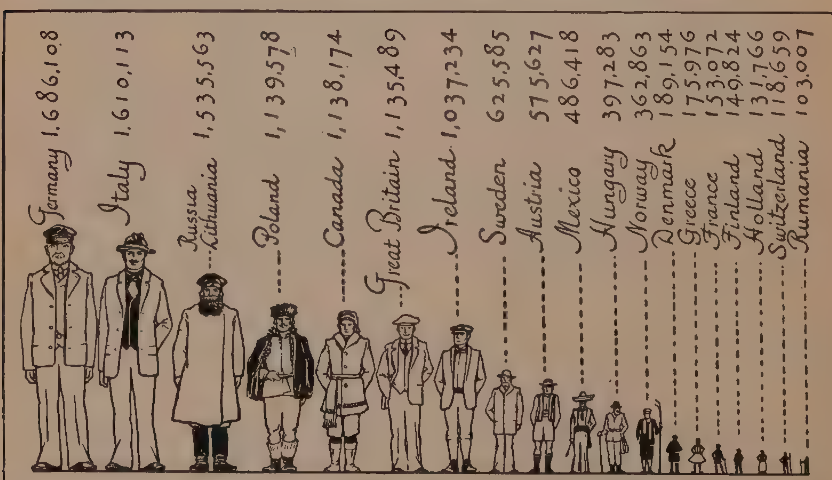


FIG. 40. This picture shows the number of foreign-born people from the world's chief nations living in the United States in 1920. What does the height of each man tell? From what countries are the largest number of our foreign-born people drawn?

HAS THE UNITED STATES ALWAYS BEEN A COUNTRY OF MANY DIFFERENT NATIONALITIES?

We have not always been such a mixed people. In 1790 the United States was the home of only a few nationalities. See figure 41. It shows that in 1790, when the people of the United States were counted in the first national census, most of them were of British ancestry; that is, 91 per cent of all the people were descended from English, Scotch, or Irish. Not only were nine tenths of the people in America in 1790 British, but nine tenths of the *British* were *English*. So you see how our people changed in a little over a century. In 1790 they were mostly of one nationality, English; in 1920 they were of more than 40 nationalities.

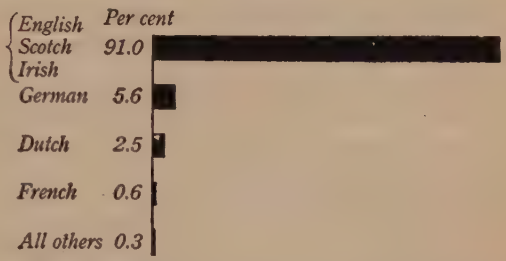


FIG. 41. This is the way the ancestry of our population was divided in 1790. What does the graph show?

AMERICANS ARE OF MANY RACES AS WELL AS OF MANY NATIONALITIES

Until about 1600 there was only one race of people living in the American continent: the red-skinned Indians. These Indians were really the first Americans.

Then came another race,— white men,— explorers and settlers from Europe across the sea. They made their homes in the land of the Indians and gradually took the land away from them. The Indians retreated slowly westward — across the eastern mountains, across the fertile valley of the Mississippi River, across the great plains, even across the high western range of the Rockies. Meanwhile a few members of the two races married. Their children became part of the mixture that is American. For the most part the white man simply conquered the red man. Today there are only a few hundred thousand of that race living in the United States.

Soon after the white people settled in North America they brought over a few men of the black or Negro race from Africa to work for them as slaves. The first shipload came in 1619. In the warm South these black people worked in the tobacco and cotton fields. Each year, for nearly two hundred years, more of them were added to the slaves already here. In 1808 Congress declared that no more slaves could be brought into the United States. Fifty-seven years later, in 1865, all who were then in the United States were set free by a change in our Constitution. Meanwhile, the Negroes had multiplied — there were many children, grandchildren, great-grandchildren. So it was that another race had been added to the United States.

Shortly after, an Asiatic race — the so-called yellow race — was added to the races already here. They came from China and Japan to work in the mining camps of the West in the 1850's and on the railroads in the 1860's, when the white men were building railroads across the western part of the United States. Some of these people brought their families. So members of another race were added to the United States. Occasionally, but not very often, they intermarried with white people.

In this country we have some people from all the races in the world.

Which are the Chief Races that compose the People of the United States?

Which are the chief races in our country? How many of our people come from the white race? from the black race? from the other dark-skinned races?

Figure 42 pictures our population of 1920 divided into two groups — whites and darker-skinned peoples (those of black, brown, and yellow skins). It shows that 11,000,000 people, or about one tenth of our population, are not of the white race. Their skins are distinctly darker, and their features are different. Their noses are flatter, cheek bones higher, or eyes slanted differently. Perhaps their hair is different. They *look* so different from the European part of our population because they belong to a different *race*.

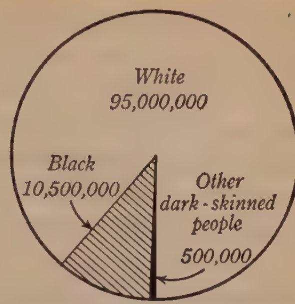


Fig. 42. This shows roughly the way the population of the United States was divided in 1920 between whites and dark-skinned people

Most of these 11,000,000 people who are not white are of one race. You can see clearly in figure 42 which race it is: the black race (Negroes) makes up nearly 90 per cent of the nonwhites in the United States. There are about half a million Mexicans (a mixture of American Indians and Spanish), less than half a million Indians, and a very few Chinese and Japanese — less than 200,000. So white people from Europe make up more than 90 per cent of the population of the United States. You will learn later, in Chapter XX, more about these people — when they came here, where they settled, and the kinds of work they found to do.

In Spite of their Mixed Ancestry Most "Americans" shared Important Traits

What was there about these pioneers that made them able to take so quickly from the earth the wealth that we enjoy today? The climate is as it was when the first immigrants came; the land, with its coal and oil, iron and gold, forests and waterfalls, was here before Europeans discovered it; but then all was unused. Today, however, all these resources have been developed. These immigrant ancestors of ours did it for us. What were their characteristics?

First of all, they were courageous. They were willing to take a chance. It takes courage to leave one's home, one's friends, one's job, all the things one knows about, and go to a strange country to begin a new life. It takes courage today, and it took courage 300 years ago. The people who came to the United States to live were pioneers. They were courageous people, willing to take a chance.

Moreover, they were ambitious; that is, they were not quite satisfied with what they had or what they were. They wanted to be better off, to have their children better off than they were.

They wanted more things, more comfortable homes, better clothes, and a better education for their children.

It is because Americans have been energetic, courageous, and ambitious that they have been able to explore this continent, to make their homes in the wilderness, to build roads and railroads across the country, to put up fine schoolhouses, and to make towns and cities. They believed they could accomplish what they set out to do. The United States today is a country of people who believe in themselves. This fact is important.

As you read in this book about the growth of roads and railroads, the invention of machines, and the building of great industries, you will find each of the great achievements in this new civilization had a tiny beginning in the energy, courage, and ambition of some man or woman. The inventors of the telegraph, the airplane, and the automobile had at first only the pictures of these things in their minds and the belief that they could make them real.

Summing up, therefore: Today we live in a civilization such as the world has never known before, partly because of our location on the earth, partly because of the natural wealth of the continent on which we live, and partly because of the settlers who came from Europe. They brought their skill and knowledge with them and were stimulated to hard work and enthusiasm. They came from older and more crowded countries in which it was often difficult to make a living. The vision of a new world, rich in land, big enough for all, free for the taking, added to their courage, their enthusiasm, and their ambition.

Who, then, is an American?

Can you tell now from your reading and class discussion what it is that decides whether a person is an American?

First, is it the color of his skin? Does it matter whether he is white or black, red, brown or yellow?

Second, is it the language which he speaks — perhaps German or Spanish, French or Russian, instead of English, which nearly all Americans speak?

Third, is it the clothes that he wears? Is a person more or less an American because he wears the white suit of a street-sweeper,

a government uniform, or the silk hat, black coat, and patent-leather shoes of a well-to-do person?

Fourth, is it the job that he holds? Does it matter whether he is a mining engineer, a clerk in a grocery store, a lawyer, a coal-miner, a cow-boy, a farmer, or a restaurant waiter?

Fifth, is it the place where he was born? Can one born outside the United States be regarded as an American? Or is it the birth-place of his father or mother that decides the matter?

Sixth, is it his citizenship? Must a person be a citizen of the United States? Must he have satisfied the requirements of the Constitution of our country?

What do *you* think decides who is an American? You will consider the problem frequently in your work in the social sciences. Try to form a sound opinion about it.

INTERESTING READINGS FROM WHICH YOU CAN GET ADDITIONAL INFORMATION

Books

Bishop, A. L., and Keller, A. G. Industry and Trade. Ginn and Company, Boston, 1923.

Chapters III and IV contain a good discussion of some of the characteristics of the American people.

Rugg, Harold, and others. America and her Immigrants. Address: Harold Rugg, 425 W. 123d St., New York City.

A supplementary reading book of episodes in American immigration (for Grades VI, VII, and VIII).

Magazine Article

"America Growing More than a Million a Year," *Literary Digest*, February 19, 1927, pp. 5–7.

UNIT III

AN INTRODUCTORY STORY OF POWER

AN INTRODUCTORY STORY OF POWER

In the three preceding chapters we have studied briefly three important reasons for the comfortable standard of living which we enjoy today: first, our favorable location in a stimulating climate; second, our large and varied territory; third, our many energetic people.

In the next two chapters we shall study men's long uphill struggle to find substitutes for the power of their muscles. In Chapter VI the story will be told of how men made power in the long ages before the invention of the steam engine. In Chapter VII we shall see how engines were invented to make mechanical power. In Chapters VIII, IX, and X our study will deal with the natural resources which have been used in modern times to run engines — coal, oil, and water.

As you study the history of mechanical power you will understand that the chief reason for our new civilization is the increase in scientific knowledge. More than 2000 years ago men in Europe began to write down their thoughts about why the world around them was the way it was. They had no way of measuring things exactly or of observing the world around them accurately. Our European ancestors lacked even such commonplace measuring instruments as clocks, yard sticks, compasses, telescopes, and magnifying glasses, although it is true that some of these were known to people in still earlier times. Without such instruments men made guesses concerning the stars and the movement of the sun and the earth, and the life of animals on the earth and in the sea. Gradually knowledge accumulated as they observed the same thing over and over again; slowly opinions were formed that were more than mere guesswork. It was in this way that little by little they discovered how events happened. Then, after 1600, scientists learned how to make more exact measuring instruments and, after 1700, inventors began to make practical machines and engines. After this happened, the way in which people lived together changed rapidly. Measuring instruments, machines, and engines changed the way in which people got food, made clothing, constructed roads, transported things, and built cities.

So as you study the story of power, keep in mind that one of the chief factors that has made possible our new civilization is scientific knowledge. The other great factor, which we shall consider frequently in the next five chapters, is the presence within our boundaries of great stores of coal, oil, and water. It is these three resources that have provided the fuel with which engines made power.

CHAPTER VI

HOW MEN MADE POWER IN THE DAYS BEFORE THE STEAM ENGINE

The history of power tells us much of the story of civilization

Not so long ago man depended altogether on human muscles or upon the muscles of animals, upon the wind and the water, for help in doing his work. Today he depends chiefly upon machines run by engines.

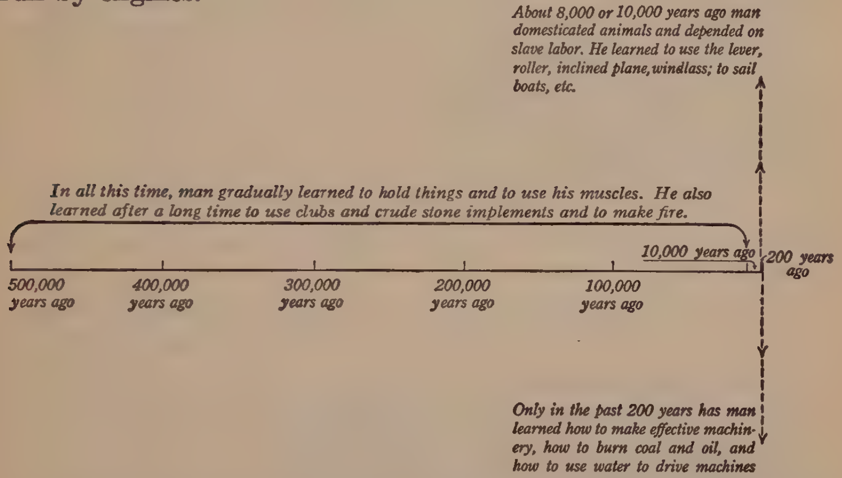


FIG. 43. This is a time line on which are summarized a few of the chief movements in the history of power. It reminds us that for hundreds of thousands of years the only kind of power which men knew how to use was that supplied by the muscles of animals and human beings, and by wind and water. Throughout this long period man was the slave of nature. Only in the past 200 years — a period so short that we really cannot mark it off accurately on this time line — has he learned how to make mechanical power

So great has the number of engines become that it is practically impossible to estimate the amount of mechanical power that we use today in the United States. The total would include the power made by millions of automobiles, by tens of thousands of railroad

locomotives, by almost numberless factories and electric-light, heat, and power plants, by electric railroads, by radio stations, and by a vast number of smaller sources. Practically everything we do today in providing food, shelter, clothing, and recreation depends upon mechanical power. Engines drive the machines on our great farms. Engines propel the trains and motor trucks that transport our food, coal, and other raw materials, and our manufactured goods. Engines supply the power that lights our houses and stores, and sends messages by telephone, telegraph, and wireless. It is only within the last 100 years that many people have had the aid of engines. Indeed, for only about 50 years have machines been doing most of our work.

Fig. 44. For tens of thousands of years ancient man was his own beast of burden. He had not even learned to make animals work for him

Early man had no power but his own strength to do his work. His only tools and weapons were stone implements and the clubs which he broke off from the branches of trees. Many thousands of years passed before he learned even to make smoothly sharpened implements out of stone, implements which he wielded always with his own hands. During all that time he knew nothing about iron and, of course, was ignorant of such a thing as steel. He walked. He had no tamed horses to ride. He had no roads and no wheeled vehicles. His only means of transportation were his own muscles.

For thousands of years men were the slaves of the things around them — wild animals, the land, and the weather. Slowly, century after century, they learned how to conquer the wild animals, to raise crops from the soil, and to protect themselves from the weather. Slowly and laboriously men advanced from their position as the slaves of nature to that of masters of nature. In this chapter we shall read a brief account of the crude ways in which ancient men learned to do their work more easily.

For Thousands of Years Men depended much upon Animal Power and Human Slave Power

After a long time, but before written history begins, man made friends with animals. Instead of warring against them, hunting them with bows and arrows, he tamed them and made them work for him. The dog and the horse were probably among the earliest animals to be tamed by man. He taught them to help him with his heavier work, and in return he fed and protected them.

Fig. 45. In the cold countries of the arctic region men still use dogs as means of transportation. This picture shows a United States postman delivering mail in Alaska. (Courtesy of the United States Post Office Department)

Figures 45, 46, and 47 illustrate the use which men have made of animals to help them in their work. In the high plateaus of Central Asia they learned to use the horse to transport themselves and their belongings. The great desert regions of northern Africa and Arabia lacked water, and because camels can go long distances without water, the few men who lived here tamed camels and taught them to work. In the hilly lands of Asia Minor the small but hardy ass was used. In India the elephant was taught to lift great logs and pull heavy carts,—men's first power aids!

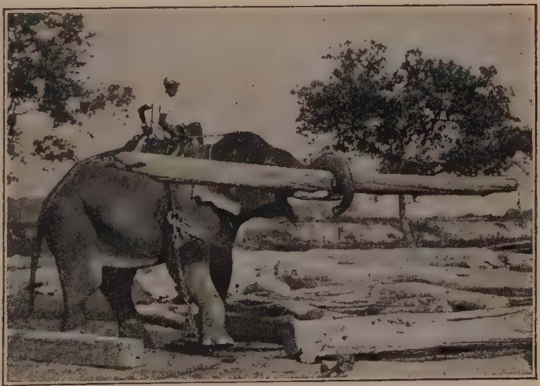


Fig. 46. The elephant too was tamed and trained to work for man. Here he is shown as a combined freight and passenger train

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Fig. 47. In the hot countries of Africa men learned to make the wiry camel transport themselves and their freight

Men not only used animals to do their work, but also compelled other human beings to work for them. For example, when they learned how to make boats, they used human slaves to propel the boats with long oars. In the picture of figure 48 the artist shows two ancient ships propelled by the power in the backs and arms of slaves.

We know that as long ago as 3000 B.C. men had learned to live together in settled ways. At that time there were civilizations in several fertile river valleys in different parts of the earth — in Egypt, in China, in India, in Asia Minor, in Central America. In Egypt, for example, people lived in cities. They

Fig. 48. As civilization advanced men made slaves of other men. Lacking mechanical power they used the power of other men's backs, arms, and legs. In this picture the artist has shown how human beings propelled ancient ships by means of long oars

raised roofs over their houses. They built good roads and stone aqueducts which held and transported water over long distances. Already men had climbed far from savagery toward a civilized way of living together. In each of these civilizations, however, mechanical power was lacking; food, shelter, and clothing were still provided mainly by the use of muscles.

Fig. 49. This drawing shows the way the artist thinks the pyramids were built. Here men are seen pulling, pushing, and lifting blocks of stone. (Courtesy of the United States National Museum)

Nevertheless, as has been said, men did succeed in building massive structures. For example, about 5000 years ago the Egyptians built the huge pyramids. The pyramids were tombs in which they buried their kings. The largest of these, the Pyramid of Cheops, stands today much as it was when it was built about 2900 B.C. Almost five hundred feet above the desert this giant stone monument rises. It was built of more than 2,000,000 blocks of limestone, each block weighing two and one-half tons and each standing about six feet in height, arranged in huge steps.

How could men have erected this heavy stone structure? With great steam-driven derricks and other lifting machines like those which the artist imagines for us in figure 50? No, the pyramid was built by human arms and backs. It took 100,000 men thirty years, working three months in each year, to build it — a marvelous achievement for those days. Giant blocks of limestone

had to be carried across the Nile River, dragged to great heights, and pushed and lifted into place by sweating bodies.

Even with many slaves, however, such enormous weights could not have been lifted had the Egyptians not discovered how to use simple tools to increase their muscle power.

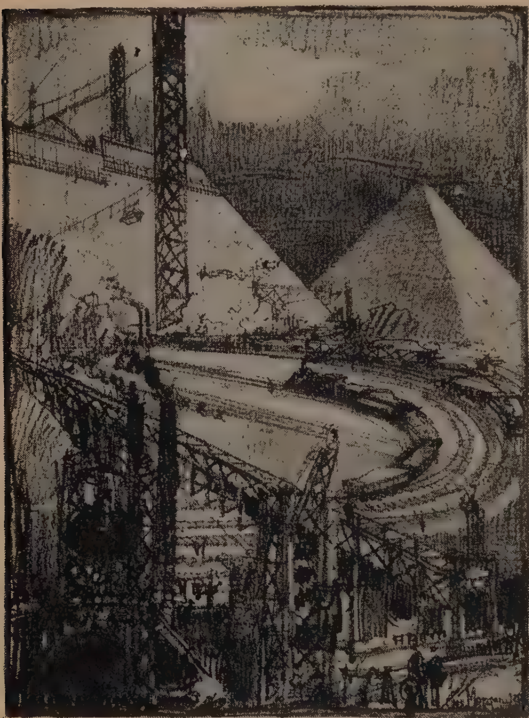

Fig. 50. This is the way the artist imagines that the pyramids could be built today — with railroad trains, steam shovels, steel traveling cranes, and other kinds of modern machinery. By comparing this picture with figure 49 you will note two important differences: first, in the number of human beings engaged; second, in the kinds of power employed. (Courtesy of the United States National Museum)

Some of the Simple Tools Man Learned to Use

In Egypt and in the other early civilizations men knew how to increase their power by using such simple aids as the roller, the inclined plane, and the lever. They learned that heavier objects than they could possibly move by the power of their muscles alone could be moved easily when they were placed on rollers. Note the three rollers under the block of stone in figure 51. They learned also that massive things, too heavy to be lifted directly, could be moved to great heights by being placed on rollers and, by pushing and pulling, rolled up a smooth incline.

They likewise learned how to use the *lever* to increase their power. This is illustrated in both figures 51 and 52. In figure 51 the workman at the right, standing behind the foreman, is helping

Fig. 51. This picture of a model illustrates how men moved heavy loads with the aid of rollers, inclined planes, and levers. Three of the workmen in the picture are shown pulling a heavy block of stone up an *incline*, with three round *rollers* under the block, helping to move it forward and upward. Another is prying under the block with a *lever*. (Courtesy of the United States National Museum)

to move a block of stone by prying under it with a metal rod, or bar. This bar is called a *lever*. The lever works on the same principle as a seesaw, or teeter. A small child could lift a heavy man on a seesaw if the board were much longer on the child's side than on the man's side. This is because the seesaw increases the effect of the child's weight. The lever works the same way. For example, workmen pry off the lids of heavy packing cases with iron bars, which are levers. The bars increase many times the effect of the workmen's weight and the strength of their muscles.

The use of the lever in lifting is also illustrated by the way in which many peoples have lifted water. See figure 52. Note that by hanging the pole and the bucket in a certain way, men used the weight of the pole to help them to lift the bucket filled with water. The pole was made short and heavy at one end and long and light at the other. The bucket was hung on the light end. This was pulled down to the river and filled with water. Then the man who was drawing water bore down on the heavy end of the pole; the extra weight of the pole helped his weight and

Fig. 52. This photograph was taken in recent times on the island of Rhodes in the Mediterranean, but excepting for the modern dress of the people in the picture it might be one of old Egypt. (Courtesy of the United States Department of Commerce)

strength to swing the bucket up to the level of the land, where it was easily emptied.

Perhaps you can think of other ways in which men have learned to use the principle of the lever to help them to lift or move things.

The Windlass: Another Device which aided the Power of Men's Muscles

Men increased their power when they invented the windlass.

Figure 53 illustrates how the windlass is sometimes used today in the United States in drawing water from a well. The handle, or crank, shown in the picture is turned by human muscles. The crank turns the rod, or roller, to which is attached a rope or chain with a bucket fastened on its end. The turning rod winds up the rope and this pulls up the bucket. In this way water can be lifted with little effort. Most of the strain is borne by the turning rod.

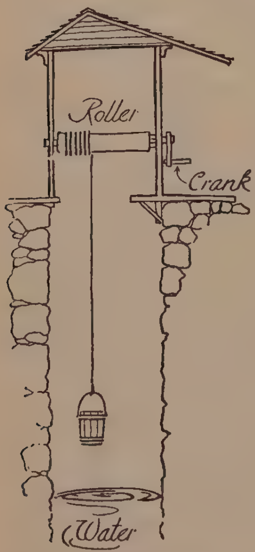

Fig. 53. This illustrates how the windlass is used in lifting water from a well

Interesting stories of the use of the windlass have been passed down from early times. Archimedes, for example, regarded as one of the first scientists and inventors, knew how to use its principle. He lived over 2000 years ago in Syracuse, a Greek city in Sicily.

One day Archimedes said to King Hiero that with his own strength he could move any weight whatever. He even said that if there was another earth to which he could go, he could move this earth wherever he pleased. The king, full of wonder, begged of him to prove the truth of his statement by moving some very heavy weight. Whereupon Archimedes caused one of the king's galleys to be drawn ashore. This required many hands and much labor. Having manned the ship and put on board her usual loading, he placed himself at a distance and easily moved with his hand the end of a machine, . . . drawing the ship over the sand in as smooth and gentle a manner as if she had been under sail.[1]

[1] Elmer Ellsworth Burns, *The Story of Great Inventions*, pp. 1–5. Harper & Brothers, New York, 1910.

Archimedes used the principle of the windlass in moving the heavy ship. Ropes attached to the ship were wound over turning rods as is the rope of the bucket in figure 53.

The windlass is still used today, but, for the most part, the crank is now turned by engines. However, the principle of the windlass makes it possible for men to move heavy objects. For example, the heavy iron anchors of ocean ships are lifted to the deck by winding the anchor chains on giant iron spools, or drums. Ships, too, are moved into docks by means of the windlass.

Men invented Windmills and Water Wheels to help them to do their Work

The roller, the inclined plane, the lever, and the windlass were all devices which *aided* men's muscles. Not content with these alone, men found actual *substitutes* for their muscles. They invented windmills and water wheels to make the wind and water help to do their work. With windmills they used the power of the blowing wind; with water wheels, the power of flowing streams.

How long men have known how to build windmills we do not know. We know, however, that they were used long, long ago. Windmills are great revolving arms attached to high towers or buildings as shown in the old New England mill in figure 54. The arms, called vanes, slanted slightly to catch the wind, are turned by its force. The wind wheel is attached to a rod, or shaft, inside the mill. Long ago the shaft was attached to grinding-stones, which ground grain. Thus the force of the wind turned the wheel; the wheel turned the shaft; the shaft turned the grindstones. In this way the force of wind was used to grind grain into flour.

Of course the wind did not always blow, but when it did the power obtained from the windmill was much greater than that in the muscles of man. Nearly everywhere in the world where people live in civilized ways you will find windmills. They can be seen today in any farming region of the United States. In Illinois, Indiana, Iowa, and other agricultural states nearly every farmhouse has its windmill. Today, however, these windmills are seldom used for grinding grain. They are usually attached to pumps, thus giving the farmer an inexpensive way of raising water from his well.

Flowing water was another of nature's great forces which men learned to use in doing work. There is power in moving water. Waterfalls, swift-flowing mountain streams, and broad, deep rivers are very powerful. Long, long ago it occurred to men that the power in these falls and streams might be made to work for them. To use this power they invented water wheels. By means of them the force in moving water was used to turn wheels and thus to do work. The force of the current pushing against the paddles or

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Fig. 54. This old-fashioned windmill, which is still standing in Nantucket, Massachusetts, was built in 1746. The wind turned the huge arms and these turned the grain-grinding machinery which is inside the mill

Fig. 55. A mill and water wheel built years ago. The water pushing against the blades, or paddles, turned the water wheel; this in turn revolved the grinding-stones inside the mill. (Courtesy of the General Electric Company)

dropping down upon them turned the wheel. This wheel, like the wheel of the windmill, might turn grindstones inside the mill.

The power in water wheels was also used to saw logs into lumber, to run looms for weaving cloth, to manufacture paper and other things.

Thus windmills and water wheels saved man's strength. For the first time he had harnessed nature as he had harnessed animals, and wind and water were now working for him. They were giving him greater amounts of power than he could produce with his own muscles. While windmills and water wheels could not make very great amounts of power, at least the power that they did produce was something which men got without using their arms and backs. The invention of windmills and water wheels therefore occupies an important place in the story of power. Men were beginning to use nature's forces to help them.

Throughout thousands of years, therefore, men depended on muscles, wind, and water as their chief sources of power

But the wind cannot be depended on to blow all the time and streams dry up in summer. Men wanted something more dependable than breezes and brooks. For a long time they asked: Are there not forces in nature more powerful than anything we now know which can be made to slave faithfully for us? At last, almost in our own time, they found such forces, and with them they learned to make gigantic amounts of mechanical power.

Everything that we have and nearly everything that we do in the United States today depends upon *mechanical power.* A considerable amount of work is still done by hand, but mechanical power does most of the heavy work. Our goods are largely made by power-driven machines. Without mechanical power, trains and ships would not run, cities and towns would not be lighted.

Without the inventions which made possible the production of mechanical power, we should still be living the kind of life our forefathers did; indeed, much the same kind of life men lived thousands of years ago. To the story of these inventions we turn in the next chapter.

INTERESTING READINGS FROM WHICH YOU CAN GET ADDITIONAL INFORMATION

Books

*Bridges, T. C. The Young Folk's Book of Invention. Little, Brown & Company, Boston, 1926.

An excellent book, easily read and well illustrated. In Chapter I (Primitive Inventions) and in Chapter II (Discoveries of the Ancients) there are good descriptions of some early power-making devices.

*Marshall, Leon C. The Story of Human Progress. The Macmillan Company, New York, 1925.

The facts of this book are well written and illustrated; it is an unusually good source of information. See Chapter I (Early Man's Feeble Powers: the Mere Beginnings of Tools and Communication) and Chapter II (The Greater Powers of Later Man: the Benefits of Tools, Communication, and Social Organization).

Marshall, Leon C. Readings in the Story of Human Progress. The Macmillan Company, New York, 1926.

See especially Chapter I (Neanderthal Man's Feeble Powers: the Mere Beginnings of Tools and Communication) and Chapter II (The Greater Powers of Neolithic Man: the Benefits of Tools, Communication, and Social Organization).

CHAPTER VII

HOW MEN INVENTED ENGINES TO MAKE MECHANICAL POWER

The story of mechanical power is the story of engines. It is the story of man's successful invention of the steam engine, the gas engine, and the electric engine. It is also the story of many unsuccessful attempts at making mechanical power by queer and impracticable sun engines, tide engines, and even freezing-water engines. But from all this experimentation, successful and unsuccessful, three kinds of practicable engines have resulted which are the very foundation of our new civilization. These are the steam engine, the gas engine, and the electric engine.

1. The Steam Engine: an Invention which gave Men Mechanical Power and changed their Whole Way of Living

There is power in steam. For centuries men knew this and dreamed idly about it. But millions and millions of people lived and died before a way was invented to capture and harness this power and make it do useful work.

A drop of water, when it becomes steam, fills 1700 times as much space as it did when it was water! In expanding, the steam, *if it can be tightly inclosed,* generates a very large amount of force. For a long time men *guessed* that this force could be used to move things, but not until after A.D. 1600 did inventors combine their knowledge of steam and invent an engine which would do it. When they did so, however, the result was the steam engine. This marked the beginning of our new and industrial civilization.

The story of the steam engine really begins about 2000 years ago. Even as long ago as that there were men wondering about steam. They were playing with the idea of what steam could do.

About the year A.D. 50, or perhaps even earlier, one of these

FIG. 56. This is the way some scientists of today think Hero's "steam ball" looked. Although it was only a toy, it can be regarded as one of the earliest steam engines of which we have any record. (Courtesy of the United States National Museum)

scientists, Hero, of Alexandria, invented a "steam ball." It was a device by which power from steam was made to revolve a ball. Figure 56 gives you some idea of the way it was done. The water was heated in the lower ball and turned into steam. The steam, rushing up through the vertical black tube, entered the ball above and came out into the air through the four nozzles which you can see in the figure. The force of the steam rushing out through the nozzles caused the ball to turn. Hero and his friends enjoyed watching this. Although to them the device was but an interesting toy, it was really a crude engine.

Can you imagine what might have happened in the next few hundred years if Hero or some other scientist had seen that *useful work* could be done by *inclosing the steam* in a more powerful kind of engine? But for many centuries no such scientist discovered that fact. Not until after A.D. 1600 did men invent steam devices which could do useful work. Even the ones that were made at that time were queer-looking devices and not very practicable. One of these is illustrated in figure 57.

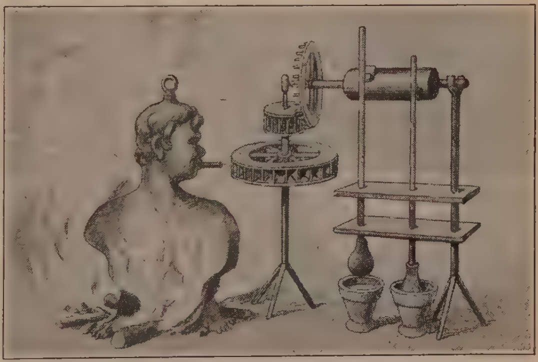


FIG. 57. About 300 years ago an Italian inventor, named Branca, made this queer-looking "steam engine." Can you figure out how the force of the steam that comes from the mouth of the image is used to grind the grain? Note how the wheel is used to turn another wheel

Pushing the Piston

By making steam move a piston inclosed in a hollow cylinder men made their first practical steam engine

Denis Papin (1647–1712?) was the first man to think of using steam in a closed tube, or cylinder, and of making it work *inside* the cylinder, where its force would not be lost. This is the same idea as that of the pea-shooter — a device which every schoolboy knows today and every boy probably knew in Papin's time. Savages long ago used the force of their breath to blow poisoned arrows through a tube. The same principle is used in modern guns, in which gunpowder forces the bullet through a steel tube.

Papin thought of using the old pea-shooter device with steam. In the cylinder, instead of a pea or wad such as a boy uses, he placed a disk called a piston, which fitted just loosely enough so that it could move through the cylinder. At the bottom of the tube, or cylinder, water was heated and turned to steam. When it turned into steam it occupied more space. Hence the steam pushed the piston through the cylinder. As the steam cooled, its force was lost and the piston moved back through the cylinder again.

Papin's engine did not work very well, but men perceived that the piston idea was a good one. They gave up trying to use the force of steam coming from nozzles, or spouts, and turned to perfecting the use of pistons inclosed tightly in cylinders. Not until Europeans began to use coal in quantities was a practicable engine invented.

In the 1600's and 1700's the coal mines of England were being dug deeper and deeper. As the coal was taken out, the mines nearly always filled with water. This water had to be forced out by hand pumps. It was expensive to do this; so mine-owners offered rewards for the invention of an engine that would run the pumps.

By 1700 several inventors had succeeded in building crude steam engines which could be made to operate pumps. Thomas Newcomen was the most famous of these steam-pump inventors. His pumping engines worked somewhat better than the hand pumps; but they were usually unsatisfactory, because they were always getting out of order. Fifty years more passed before a really practicable steam engine was made.

James Watt (1736–1819), "the Father of the Steam Engine"

In the year 1763 a Newcomen pumping engine in the Scottish University of Glasgow got out of order. It was taken to James Watt, an instrument-maker in the city, to be repaired. Watt studied the engine carefully and in repairing it discovered how to make a much more practicable engine than had hitherto been invented. He observed that in the engine which he was repairing the force of expanding steam was used to push the piston *only one way*. Consequently much of the force of the steam was lost. In the engine which he invented, the expansive force of the steam was used to push the piston both ways. For nineteen years Watt worked at the task of improving his engine, and in 1782 secured an English patent on it.

Fig. 58. This shows an engine built by James Watt in 1776. It was actually in service for 120 years. Although the illustration does not show how the engine worked, it is included here because it is one of the most historic of steam engines. This engine is now preserved in England as a memorial

James Watt is called the Father of the Steam Engine because he was the first to make it practicable. The steam engine as he constructed it is in principle the same as the engine that we use today. Of course since Watt's time steam engines have been made much more efficient; but in the great locomotives that pull our transcontinental trains and in the engines in our power plants, there are cylinders with pistons moved by steam much as they were in Watt's engine over 150 years ago.

Figure 59 shows how a modern steam engine would look if it were cut down through the center, so that we could look inside. The cylinder is shown at A. Within it is the piston B, which is moved from one end of A to the other by steam entering first at C and then C'. The position of the valve D determines where the

steam will enter. This valve opens and closes as the steam goes through. When it is in the position shown in figure 59, the steam enters through the opening *C* and forces the piston to the other end of the cylinder. The steam is brought from the boiler (not shown here) through a pipe *H* into a space *I*, called a steam chest. From this steam chest it enters the cylinder through the openings *C* and *C′* just mentioned. When the piston is being forced to the other end of the cylinder as is shown here, the piston rod *E* passes through the front head of the cylinder. The steam which has previously moved the piston must have some means of escape. It passes back through *C′*, under the valve *D*, and out through an exhaust pipe *J* to the air. After this stroke, as it is called, is completed, valve *D* will have moved to cover opening *C* and uncover opening *C′*. Steam will now enter from the steam chest through *C′* forcing the piston towards the left, while the steam from the previous stroke will escape through *C*, under the valve *D*, to the air at *J*.

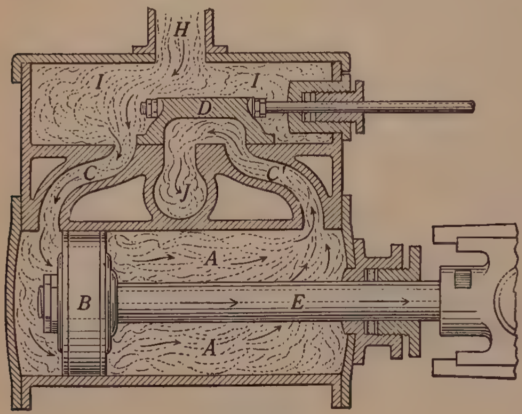


Fig. 59.

Wider Use of the Steam Engine

No sooner did Watt perfect his engine than Americans began to use it and the ideas upon which it was constructed. Even before the Revolutionary War, crude engines for pumping water had been used in the copper mines of New Jersey. Shortly after 1800 Oliver Evans, one of the first inventors of the United States, experimented with the use of engines. The Philadelphia Board of Health requested him to make a machine to dredge the river and clean the docks. He constructed an engine in 1804 and attached it to a dredging machine. This queer machine (shown in figure 60) could be used either on land or on water. It puffed and snorted

on wheels through the quiet Philadelphia streets. To the astonishment of the people, when it came to the Schuylkill River it kept right on going out onto the water. This dredge, which worked successfully either on land or on water, was but one of many ingenious machines that Evans invented. He was rightly called the "James Watt of America."

In Chapters XIV, XV, and XVI is described the manner in which the steam engine was applied almost at once to vehicles on

FIG. 60. Oliver Evans's Oruktor Amphibolos, a combined land-and-water vehicle. This caused great amusement and consternation as it passed the waterworks in Philadelphia in 1804. It is regarded as the first self-propelled vehicle to run on American soil. (From a painting by Clyde O. De Land. Courtesy of the Continental Insurance Company)

sea and on land. The steamboat, for example, was made by attaching a steam engine to the paddles which propelled the boat. Railroads with horse-drawn cars gave way to railroads with cars driven by the power in steam engines. Likewise the first steam-propelled road vehicles were made (about 1800) by attaching a steam engine to the wheels of a wagon.

In recent years there has been invented a new kind of steam engine called a *turbine*, from the Italian word *turbine*, meaning "whirlwind." It was invented by an Englishman named C. A. Parsons, and brought about a very great change, particularly in

engines used in ships and power stations. In the turbine engine used on ships the force of steam is used to turn the blades of a wheel inclosed in a steel cylinder. The wheel is connected to the propeller, which is fastened to the ship under the water. The blades of the wheel revolve rapidly from the force of the steam, causing the propeller to whirl about in the water, so that it moves the boat forward.

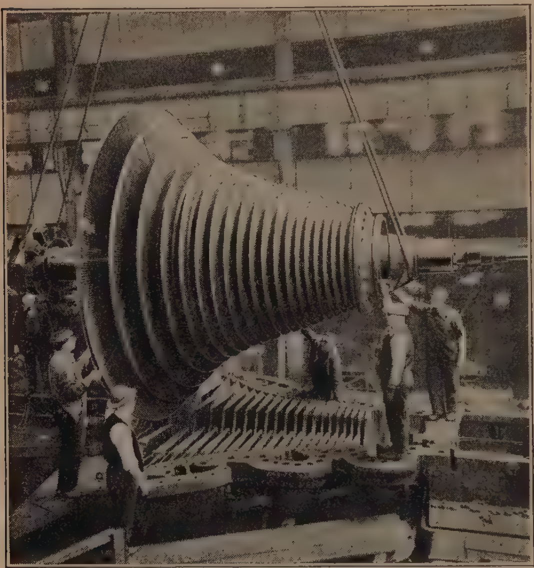


Fig. 61. This giant turbine turns with a force of nearly a hundred thousand horses pulling together. To turn it with such mighty force, steam is driven at high speed against hundreds of blades. (Courtesy of the General Electric Company)

In 1897 this new kind of engine was installed in a small boat called the *Turbinia*, which broke the speed records for boats of all sizes. To-day steam turbines turn the huge under-water propellers, or screws, which run the fastest merchant and passenger ships, such as the *Mauretania* and the fast navy cruisers. Turbines have replaced other kinds of steam engines in the running of many of our big power plants.

2. The Gas Engine: Another Important Invention which greatly increased our Mechanical Power

The force used in the steam engine was made by water expanding into steam. Now steam is a kind of vapor. For a long time scientists knew that other things besides water have great expansive force when heated and turned into vapor. So when men had once mastered the principle of pushing a piston by inclosing steam in a cylinder, they tried to find other substances that would exert

an even greater force when turned into vapor than could water. One of these substances which worked successfully was gasoline.

Water changes to steam when heated; but it is not burned. It merely expands and when cooled changes back into water. Gasoline, however, is different. When heated it too expands rapidly and becomes a gas. When the gas is brought in contact with the tiniest spark, it explodes. Men found that by exploding this gas inside a cylinder by means of an electric spark a great deal of power could be made. Such an engine is called a gas or internal-combustion engine.

Gas engines have one very great advantage over steam engines. They are less heavy and bulky. A steam engine requires a heavy boiler, a supply of water, and fuel with which to heat the water; hence it must be large. A gas engine, on the contrary, needs merely a supply of fuel — gasoline, naphtha, or whatever it uses for vapor — and can thus be made smaller. So the gas engine was found to be best for small boats, for automobiles, and for airplanes. Tractor pumps and mowing machines are also equipped with gas engines. Indeed, the gas engine is used pretty generally nowadays in small machines.

3. Electricity: the Power that can be sent over Long Distances

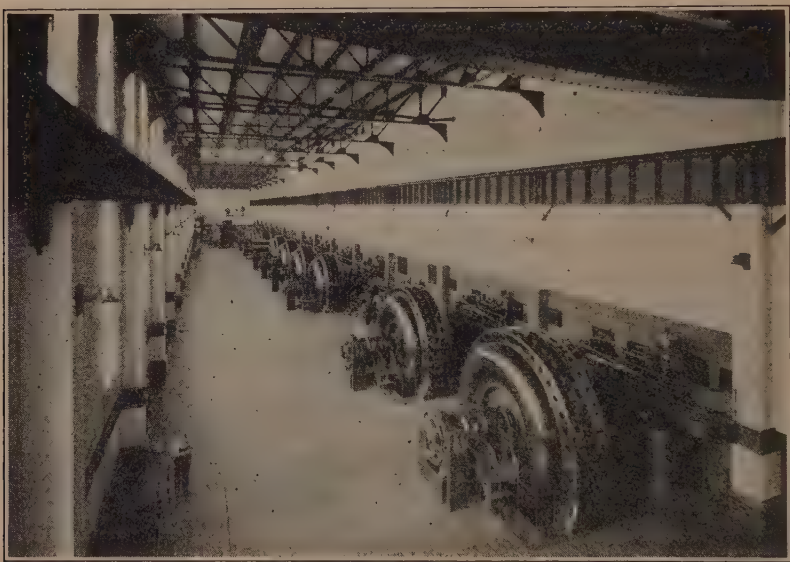
There is, however, a third form of power — *electricity* — and correspondingly a third kind of engine — *the electric generator.*

Today when we press a button and a light appears in a dark room, we seldom think of the story of electrical power behind that bright bulb. Nor when we see a long electric passenger train gliding along swiftly and silently, do we stop to consider that at some distant place huge machines for making and sending electricity are working night and day to keep it moving.

You know, of course, that lightning is electricity. You know, too, that electricity is powerful, for perhaps you have heard of houses being destroyed by it or of people being killed by it. You will readily understand, therefore, that if it could be caught and its power used, it might move heavy trains and operate machines of tremendous size. Although we do not know how to control the

power in lightning, we have learned to make electricity and to harness it so that its power will work for us. Many, many scientists experimented with the idea before any practicable way of making electrical power was discovered. The first step was the invention of the magnet.

You know, of course, what a magnet is. Many years ago a famous English scientist, named Michael Faraday, discovered (1831) that when wire is moved to and fro over a magnet an electric



© Keystone View Co.

Fig. 62. Great generators like these supply a large amount of our mechanical power

current is developed in the wire. He and other inventors since his time experimented with magnets and moving copper wires. They learned that if one wire were wound many times around a cylinder and the cylinder turned rapidly inside a magnet, an electric current would flow through the wire. Then they learned that many wires wound around the cylinder would produce larger amounts of electric current. After many experiments large *generators*, as the machines which make the electricity are called, today produce great amounts of power.

Another important fact which our inventors learned was that these copper wires when extended outside the generator would

carry their electrical power for hundreds of miles. At these distant points they could light lamps, turn motors, and so forth.

This was one of the most important additions to scientific knowledge. To make power in one city and use it in another, or

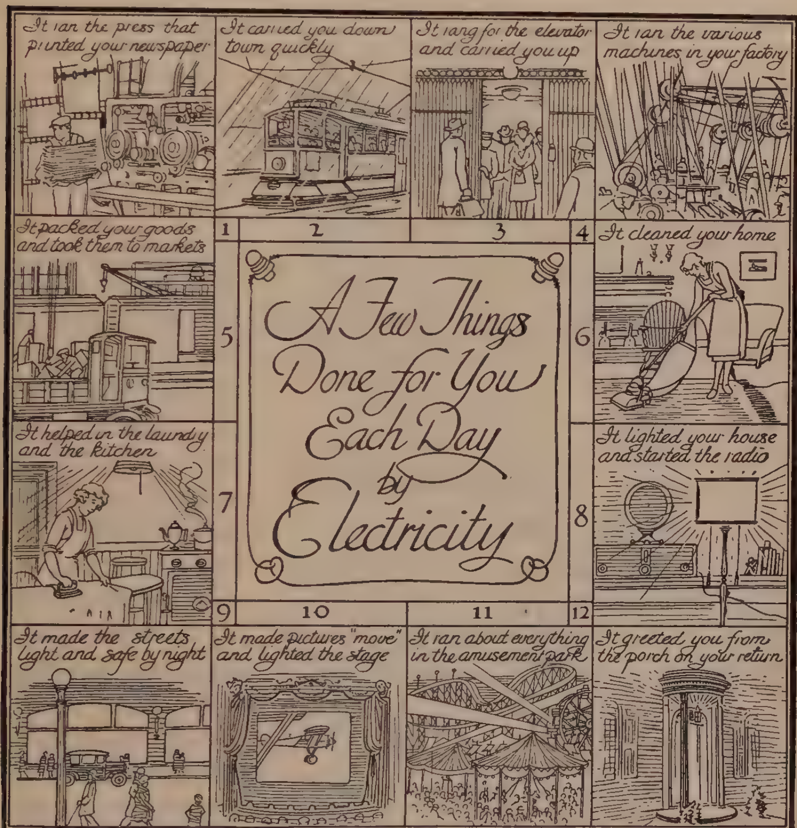


Fig. 63. How electricity works for you

even in another state or country, seemed to be a dream that would never come true. It has come true, however, through the efforts of Thomas Edison and other inventors.

As a result of their inventions, electrical power stations are being built in nearly every section of the country. In 1927 one large company was sending power over wires a distance of 600 miles. Some scientists think that a way may be found to transmit electrical power even without the use of wires!

You see, then, how at last electricity was made and put to work by man. It not only lights many homes, but it also makes great amounts of power for us. Figure 63 reminds you of the ways in which it reduces the labor of our everyday life. It helps to transport us and our goods quickly. It lights our houses and our streets. It cleans our homes, and cools them in summer. It runs some of the machines in our factories and many of the presses that print our newspapers. It makes our moving pictures and lights the stages in our theaters. It makes possible the pleasure that we obtain from the radio.

The United States is Today in an Age of Giant Power

An amazing amount of mechanical power is made today by our steam engines, gas engines, and electric engines. Just how great this power is we do not know; we can only estimate it. One estimate for 1925 is 435,000,000 horse power![1] Figure 64 presents an estimate of how this power was used. More than one half of it was used in automobiles; about one sixth in locomotives; about one tenth in merchant vessels; other large amounts were used in manufacturing, in electric-light-and-power stations, in naval vessels, in street railways, and in various other ways.

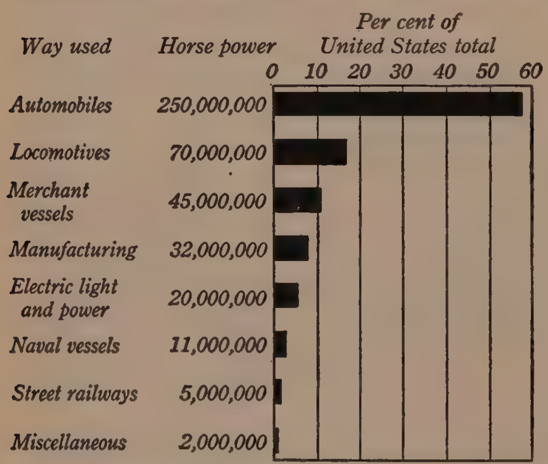


Fig. 64. Estimated amounts of power used in various ways in the United States in 1925

[1] What is meant by horse power? Try to think of the most powerful horse you have ever seen; for example, one of those fine strong horses that some cities still use to pull fire engines. Try to think how much work such a horse could do. About the time that steam engines were invented, engineers tried various ways to measure the power that their engines were making. James Watt suggested that the unit of power should be the amount of work that an average horse could do in a minute. This was to be called one horse power.

In agriculture and industry engines have greatly increased man's power

The pictures of figure 65 remind us that engines have multiplied many times the amount of work that a man can do in farming. In the upper picture a man is shown threshing grain with a flail. In the lower one a man is threshing it with a power-driven harvester-thresher. One man with a flail can thresh only a few bushels of wheat in a day. Today a harvester-thresher both cuts and threshes from 80 to 160 bushels in an hour. The amount of work which one farmer can do has been multiplied not less than a hundred times by the invention of an engine which can propel the machines with which he sows, cultivates, and harvests his crop.

Fig. 65. When threshing with a flail one man could harvest only a few bushels of grain a day. The harvester-thresher can cut and thresh absolutely clean wheat at the rate of 160 bushels an hour. (Courtesy of International Harvester Company)

The same great change has come about in other industries. Power-driven machines have entirely changed the manufacture of things. With their aid a single workman in a factory can do many times the work of a man who uses only a simple hand tool. (See Chapter XII.) In the days before the steam engine a weaver, for example, using a hand loom could weave only a few yards of cloth in a day. Today, because of mechanical power and machines, a weaver tending a score of looms can weave hundreds of yards in a day. Certainly the amount of work which he can do is many

times as great as that which could be done by a weaver before the days of mechanical power. Engines have produced a corresponding change in all the other industries. For example, a pair of shoes can be made by power-driven machines in from thirty to forty minutes; to make them by hand used to require that many hours.

Consider the steel industry as another example. It is one of the largest industries in the United States today. It has become so chiefly because of the invention of engines and of machines. To make the great steel columns and beams that hold up our bridges

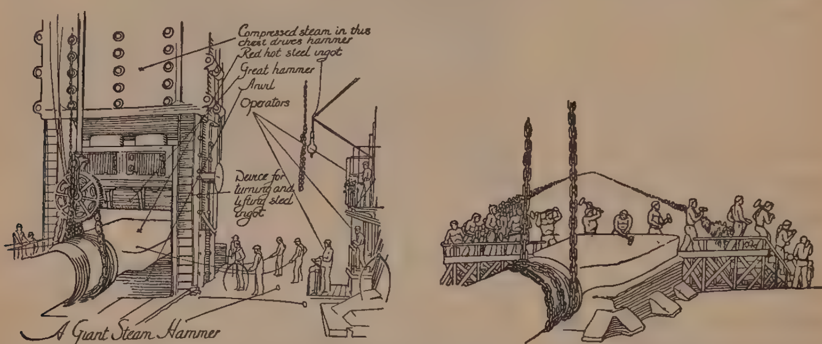


FIG. 66. The picture at the left shows a 12,000-pound steam-driven hammer ready to hammer into shape a red-hot steel bar. To duplicate one blow of the steam hammer would require roughly 1000 men, each wielding a 12-pound hammer *at the same moment and on the same spot.* The picture at the right shows how impossible it would be to get the same effect by man's muscles alone

and skyscrapers requires giant machines that can lift and pound with great force. And when made, machines weld them together.

An illustration of the need for giant power is given in the left-hand picture of figure 66. The steam hammer not only can strike with enormous force; it can also *concentrate* its force on a single small area. The right-hand drawing in figure 66 reminds us that it would be impossible for 1000 men to strike the giant steel bar at the same moment. Hence it would be impossible to *concentrate* at one spot enough force to hammer the bar.

Still another example. The largest electrical power station in the world has just been completed in New York State. This one station will produce nearly 1,000,000 horse power! Furthermore, the plant will work 24 hours a day, which is three times as long as the average man now works. This one power plant,

therefore, will produce as much power as could be made by many millions of persons.

While this is the largest electrical power station in the world, it is only one of hundreds in the United States. In every city and in most of our towns there are stations where electrical power is made and distributed.

"In the old days kings raided their enemies and came back with new captives to lift water and haul carts. Nowadays our engineers dive into the secrets of nature and return with electrical slaves to run the subways and to run pumps and to keep our streets alight."[1]

In earlier days human slaves did most of the work; today "mechanical slaves" in the form of great engines and machines do most of the work. Our engineers tell us that each family in the United States has working for it, besides its own members, more than a hundred mechanical slaves. This is more than in any other country in the world. The American workman has more mechanical power at his command and consequently produces more goods than any other workman in the world. By turning on a switch he can perform gigantic feats. He can drill a hundred holes at a time in a steel plate. He can start a long train moving. He can turn night into day. He can lift tons of iron and be himself lifted to the tops of the great skyscrapers that he has made.

These examples illustrate briefly how the power of the worker has been multiplied many times by the use of engines. In Chapter XII we shall study even more startling examples of the way in which machines driven by engines make possible our high standard of living.

We are indeed living in the Age of Giant Power.

Summary of the History of Power

This concludes our brief sketch of the history of man's long struggle to use substitutes for the power of his own muscles. Tens of thousands of years were required for him to learn how to control nature so as to make it do work for him. What, then, are the chief stages which finally led man up to the use of mechanical power?

[1] Adapted from the *Edison Monthly*.

First. He made tools that he could use with his own hands.

Second. He tamed animals and harnessed them to work for him.

Third. He captured men of other tribes and nations and made them his working slaves.

Fourth. He found ways of making the wind and the streams turn wheels for him.

Fifth. At the dawn of the scientific age he learned how to employ steam in engines to move wheels with greater rapidity.

Sixth. He learned to use gas in engines to make still greater amounts of power.

Seventh. He harnessed electricity to carry power over long distances.

Today almost all the power we use in the United States is mechanical power. No amount of muscle power could replace the mechanical power which man has called to his aid. Mechanical power means comfort. It raises the standard of living. It means more to eat, more leisure, better clothes. It means that in the United States today we live more comfortably than people have ever lived before. Many of us, indeed, live in greater luxury than even kings enjoyed a few centuries ago. You will learn later how this has been brought about, not only by engines, but by the invention of many, many kinds of machines which are driven by the power of these engines. Without these engines which drive our machines the civilization in which we live today would not be possible.

INTERESTING READINGS FROM WHICH YOU CAN GET ADDITIONAL INFORMATION

Books

*Bachman, Frank P. Great Inventors and their Inventions. American Book Company, New York, 1918.

See especially Chapter I (James Watt and the Invention of the Steam Engine) and Chapter IV (Invention of the Electric Engine and Electric Locomotive).

*Bridges, T. C. The Young Folk's Book of Invention. Little, Brown & Company, Boston, 1926.

Refer particularly to Chapter VI (The Coming of Steam) and Chapter XXVIII (Harnessing Nature).

*Kaempffert, Waldemar B. (Editor). A Popular History of American Invention. Charles Scribner's Sons, New York, 1924.

A most highly recommended reference, interestingly written and illustrated. See Volume I, Part III, Chapter I (Putting Steam to Work).

*Keir, Malcolm. The Epic of Industry (Volume V of The Pageant of America). Yale University Press, New Haven, 1926.

An excellent reference, abounding in illustrations. See Chapter V (King Coal).

Marshall, Leon C. The Story of Human Progress. The Macmillan Company, New York, 1925.

Chapter IV (Power and the Machine as Phases of Man's Harnessing of Nature) presents an illustrated history of man's invention of engines.

Van Loon, Hendrik W. The Story of Mankind. Boni & Liveright, New York, 1921.

The chapters entitled "The Age of Engines," "The Social Revolution," and "The Age of Science" bring out strikingly some of the effects of the revolution in power-making.

CHAPTER VIII

COAL: OUR COUNTRY'S MOST IMPORTANT SOURCE OF POWER

Steam engines! Gas engines! Electric engines! These are the modern makers of mechanical power!

But what runs these engines? All of them depend on fuel or on water power. Of our fuels coal is still by far the most important. Coal is burned under the boilers that make the steam that runs the engines that run the machines. Visit almost any factory and ask the manager what drives the wheels of the machines; he will probably answer "Coal." If coal were lacking, the great locomotives would stand still, the ocean liner lie idle at its dock, factory gates be closed, and the workmen's children go hungry. If coal were lacking, our steam-driven electric-light-and-power stations would stop running; many of our houses, hotels, theaters, and restaurants would be cold and dark; our streets would have little light.

FIG. 67. What is the most important conclusion that you draw from the study of this cartoon? The workmen are supposed to be saying, "But we are not on strike." Can you think of any natural resource other than coal upon which our daily lives depend so completely? (Kirby in the *New York World*; from the *Literary Digest*, September 9, 1922)

Until we begin to think of these things, we hardly realize what coal means to each one of us, — the numerous ways we depend upon it in our everyday life.

In what way does our new civilization depend upon coal?

More than five tons of coal are mined and used each year for each man, woman, and child in the United States. One of these five tons is used for heating houses and cooking. Much of the other four, astonishing as it may seem to you, enters our homes on electric wires, through water pipes, and in various disguises by way of the kitchen door.

One man estimated that he and his family used in a year thirteen and a half tons of coal which no member of the family ever saw and which were never inside his coal bin. He had in mind, of course, all the services that were performed for them outside their home. For example, more than a ton of coal was used each year at the power station to make the electric current that lighted their house and to heat the toaster on the breakfast table and the iron with which their clothes were pressed. To make their ice almost a ton of coal was used at the power station. Eleven tons were needed to produce their supply of gas for cooking and heating. A small amount was burned in the city pumping plant that pumped their water supply; another ton was needed to mill the flour, to bake the bread, and to refine the sugar which the grocer delivered at their door. Almost everything we have today makes use of the burning of coal.

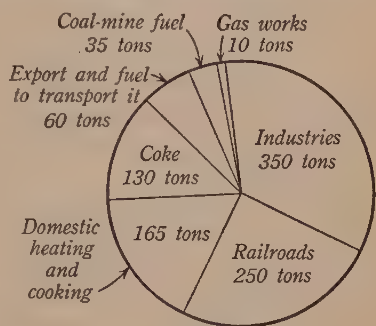


FIG. 68. How each 1000 tons of coal is used in the United States. (Courtesy of the Engineering Magazine Company, New York)

Coal is burned in the production of practically all our manufactured goods. Consider things made of steel, for example. Three tons of coal were used in making every ton of steel in our railroad cars and rails, our automobiles, our bridges, and our great city skyscrapers. To make the paper in this book requires twice its weight in coal. Most of the clothes you wear and much of your food have their cost in coal, for they were made in coal-burning factories and were transported by coal-burning trains and ships.

Although we do not see the coal that goes into the production of all these things, we must not forget that without it we could not have the comforts and luxuries of this new civilization. King Coal rules us today. His power still turns most of our engines.

How the Coal in the Earth was Made

The story of how coal formed is wrapped in a great deal of mystery and uncertainty. Little by little, as our knowledge of science has developed during the past 200 years, scientists have pieced together a reasonable account of it. Of course it may be that some of our present conclusions about the formation of coal will have to be changed. This, however, is what the scientists of today think probably happened:

The earth is very old — indeed, unbelievably old. The geologists (men who study the formation of the rocks) do not agree upon the age of the earth, but they know that it is very, very old. We can be sure that long, long ago it looked very different. At that time the earth was like a huge ball of gas and melted matter whirling in space. It was hotter than any heat of which we can think. As the earth gradually cooled, a crust formed on the surface. The highest spots on this crust became land, the *continents* of the earth. In the lower places water collected and formed the *oceans*. While the earth was so very hot there was no life on the continents or in the sea; as it grew cooler, however, living things began to appear.

The climate was damp and hot. There was much low, swampy land, and great forests grew rapidly. After many millions of years these swamp forests became covered by water and were crushed down by rocks or thick layers of soil. After many more millions of years other forests grew up in the same places. Again and again the same thing happened. The tree trunks and large branches were packed down into a hard layer of vegetable matter. Each time the forests died and were buried others grew up very slowly after a long period of time. It is believed that these underlying layers of trees and vegetable matter formed the veins of coal that we mine today.

Three different kinds of coal were formed

During the millions of years when coal was forming, volcanoes thrust great uplifted mountains of melted rock over some of the buried layers of vegetation. These hot and massive weights packed down still harder the buried forests beneath them. The result in this case was *anthracite,* or hard coal. It burns slowly and makes little smoke. Anthracite is much used for cooking and heating. Cities that burn anthracite are likely to be clean cities.

There is a second important kind of coal: *bituminous,* or soft coal. In the early history of the earth some of the layers of buried vegetation were not very hot and were weighted down only by the rocks immediately above them. Layers of this sort became bituminous coal. This coal contains much oil, gas, and tar, and burns very easily. But it makes a heavy black smoke. Bituminous coal is the fuel that makes the factory wheels turn. It is used in great quantities by railroads and ships and central power stations. Manufacturing cities like Chicago and Pittsburgh, which burn huge quantities of soft coal, show the effects of the black smoke. In the Middle Western states bituminous coal is even burned in house furnaces and kitchen ranges. Because of its heavy smoke it is often regarded by the housewives as a nuisance. New York and New England are troubled much less with the smoke nuisance, for they burn more anthracite.

The third kind of coal is *lignite.* It is often called brown coal. It is a substance still softer than bituminous coal. It was formed from vegetable matter which was under less pressure than either anthracite or bituminous coal, and therefore it is less hard. It has a woody appearance and is light and porous. It contains much water and will not burn so well as either hard or soft coal. A ton of lignite produces only about half as much heat as a ton of bituminous coal.

There are other kinds of coal than these three, but the three that we have named — anthracite, bituminous, and lignite — are the chief kinds. A ton of the best coal produces several times as much heat as a ton of the poorest. So you see it is necessary, when speaking or thinking of coal, to tell what kind you have in mind.

UNCLE SAM: THE WORLD'S GREATEST OWNER AND MINER OF COAL

For many millions of years after coal had formed, it lay in the earth unused by man. Even the great civilizations of a few thousand years ago — the Chinese, the Egyptian, the Greek, the Roman — made no practical use of this "black gold." It is said that even in 1790, when anthracite coal was first discovered in Pennsylvania, no use was yet known for it. It was thought to be too hard to burn, and was cracked up, just as stone was cracked at the time, and used to repair roads. Not until modern times did men learn how to burn it for power. Then, with the invention of engines and machines in the 1700's, the people of Europe and America began to regard it as one of the most important natural resources. Men searched the earth for coal just as eagerly as they had sought for gold, silver, gems, and other precious things of nature.

In this book we are studying the factors that made possible the great wealth and high standard of living of the United States. On page 32 we stated the second factor as "huge size and varied resources." In possessing a large supply of natural resources the United States is among the most fortunate of countries. But it is particularly fortunate in having within its borders gigantic supplies of coal.

The map and right-hand graph of figure 69 tell us where the world's coal is located. As a result of careful search engineers have found coal deposits in each of the six continents of the earth. Of course, there is still some uncertainty concerning the unused coal deposits in different regions. Even today engineers are discovering immense deposits, hitherto unknown. Because the search is becoming more careful every year, no doubt other large deposits will be found in the future.

The map and graphs of figure 69 show that today, however, Uncle Sam is the world's greatest owner and miner of coal.

Notice first that the blackened areas on the map of North America are larger than those in South America, Europe, Africa, Asia, or Australia. Then notice that the facts of the graph at the extreme right of figure 69 confirm the facts presented on the map.

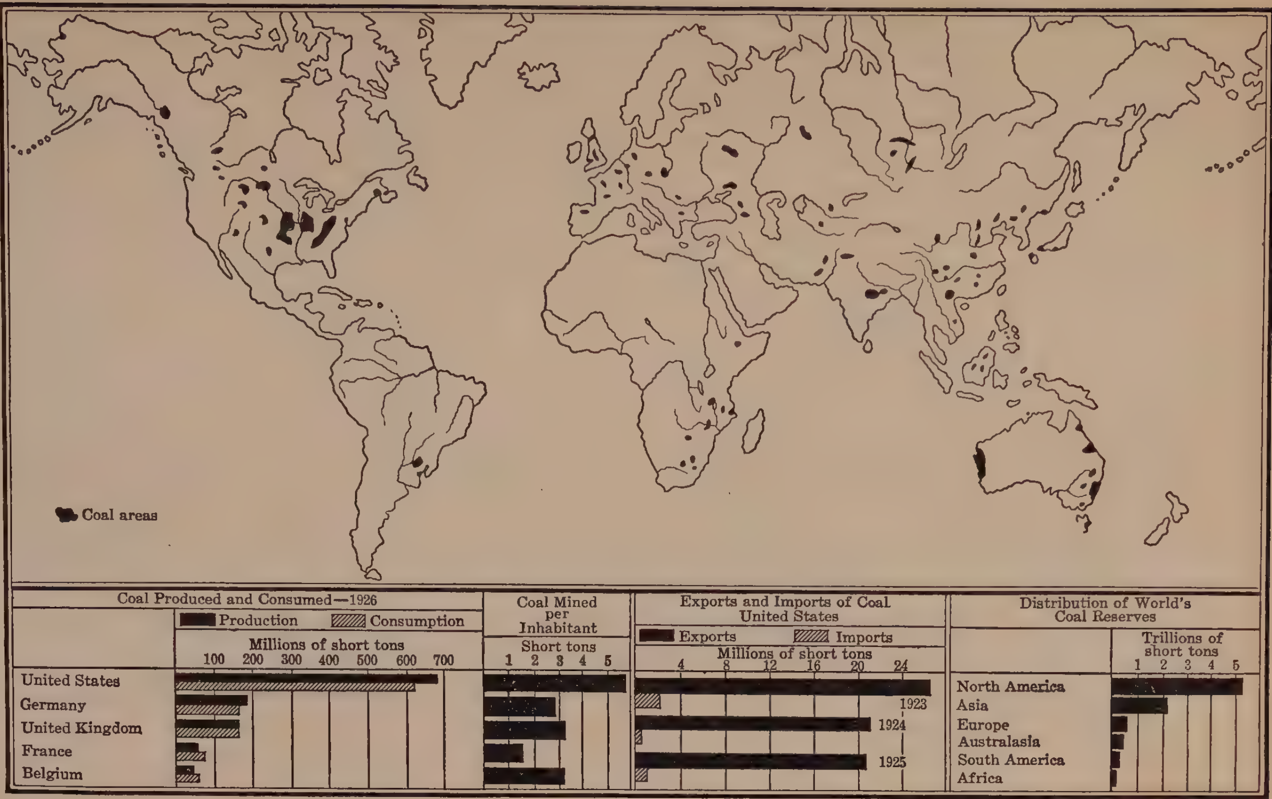


FIG. 69. The United States not only mines and uses more coal than other important countries but also exports a great deal

The graph presents the estimates of engineers and shows that to-day North America possesses more known coal deposits than all the other continents put together. Furthermore, nine tenths of these gigantic coal supplies of North America are within the borders of the United States. In this fact lies one of the chief reasons for the industrial growth of our country. Europe, the second coal-using region of the world, possesses less than one fifth as much as North America, and Africa about a twentieth.

The remaining graphs of figure 69 supply us with other important facts concerning our great wealth in coal. Not only do we own vast amounts; we also mine and use vast amounts. The graph at the left compares our production and consumption of coal with that of the four other industrial countries of Europe — Germany, the United Kingdom (England, Scotland, and Wales), France, and Belgium. In 1926 the United States produced more than three times as much coal as did either the United Kingdom or Germany, and more than six times as much as did France or Belgium. The second graph shows, furthermore, that we mined more coal *per inhabitant* than did these other countries. It is important to know this fact because we have nearly three times as many people as either the United Kingdom or France and nearly twice as many as Germany.

There is another question: Do we ourselves consume this vast amount of coal that our mines produce? The first graph of figure 69 shows that we consume most of it. Recent government statistics inform us that we use 95 per cent of the coal that we mine. The remaining 5 per cent we export; that is, we sell it to the inhabitants of other countries. The third graph of figure 69 shows that we are exporting each year more than 20,000,000 tons of coal.

Where do our Chief Coal Deposits lie?

The map of figure 70 shows more clearly than the preceding one the vast extent of the coal resources of the United States. Note carefully the three regions in which the greater deposits of coal are located. First, the Appalachian, or eastern, fields of Pennsylvania, Ohio, West Virginia, Kentucky, Tennessee, and

Alabama; second, the central fields of Illinois, Indiana, Iowa, Missouri, Oklahoma, Arkansas, and Texas; third, the western fields, covering vast territory in North Dakota, Montana, Wyoming, Utah, Colorado, and New Mexico. Of these the Appalachian and central coal fields are at the present time the most valuable. These are the ones that are being mined so extensively. These contain the better coal — the anthracite and the bituminous. The great western fields contain the poorer grades of bituminous coal

FIG. 70. This map shows the chief coal deposits of the United States. Notice first that they lie in three great general fields: (1) the Appalachian, or eastern fields, (2) the central fields, and (3) the western fields. Then notice that in the eastern fields are found anthracite and bituminous coal. The central and western fields contain bituminous coal and lignite. In the central fields is found more bituminous coal than lignite. In the western fields lies the great lignite deposit[1]

and the lignite. Although today these less valuable fields are being mined very little, some day when the fine eastern fields have been exhausted these may supply most of our coal.

Note especially on the map of figure 70 the small deposits of anthracite in Pennsylvania. Almost insignificant they appear on the map. Actually, however, they are the most valuable coal deposits in the world. Engineers have estimated, for example, that 800,000,000 tons of coal underlie the city of Pottsville alone.

[1] F. G. Baum, *Atlas of U. S. A. Electric Power Industry*. McGraw-Hill Book Company, Inc., New York, 1923.

The earth under the city of Wilkes-Barre is honeycombed with mines. So it is with the whole region.

Note these 1920 populations of several Pennsylvania coal-mining cities: Scranton, 138,000; Wilkes-Barre, 74,000; Hazleton, 32,000; Pottsville, 22,000; Shamokin, 21,000; Pittston, 18,000; Plymouth, 16,000. These are only a few of the many cities and towns that have grown up in these Appalachian hills and mountains because of the coal-mining industry. It is estimated that altogether more than 1,000,000 people now live in this region, brought there for one reason or another connected with the mining of coal.

What about the great bituminous fields? Although bituminous coal is not so valuable as anthracite, the bituminous fields are many times larger in extent. Note in figure 70 how they spread out over the three coal regions of the United States. These deposits of bituminous coal are far larger than either those of anthracite or lignite. Not only are they extensive in area; they are located advantageously for mining. Many of the bituminous coal beds in the Appalachian fields run back horizontally from hillsides. This makes them easy and relatively inexpensive to mine. In fact, bituminous coal can be mined in this region for less cost than is possible in Europe, in spite of the fact that American miners receive much higher wages than do European miners. Pennsylvania mines not only anthracite but bituminous coal as well. In fact, this state produces three times as much coal as any other state in the country. West Virginia is second; then come the states which contain the central fields — Illinois, Kentucky, and Indiana. The quality of coal in the central fields is not so good as that of the Appalachian fields.

There remain to be noted the large deposits of lignite, scattered over the central and western fields. This coal, as we said, is of the poorest grade, gives less heat and power, and produces less profit for the mine-owner. For this reason lignite is being mined in much smaller amounts than are either anthracite or bituminous.

So much for the mere facts of the location of coal in the United States. Are they important? Yes, they are indispensable to a clear understanding of where and how the people of the United

States live. In Chapter XXIV you will study the chief sections of the United States — where the American people live and what they do to get a living. There you will read more fully of the remarkable *industrial section* that has grown up in northeastern United States. This area, which stretches from the New England states west to the Mississippi River, is the most densely populated part of our country. Here are located most of the large cities. Here are most of the great iron and steel industries. Here have been built a large proportion of the factories of the United States. Here are more railroads and paved roads, improved waterways, telegraph and telephone lines, than in other sections of the country. Why? For several reasons, of course, as you will learn more fully later. Chief among them, however, is the reason that here lie great deposits of high-grade coal. Industry grows up close to the sources of power; factories, railroads, means of communication, all demand great amounts of power. It is coal, burned under the boilers of engines, that supplies the greater proportion of this power.

The Mining of Coal

Layers of coal called veins, which were formed thousands of years ago, vary in thickness from 60 feet to the thickness of a blade of grass. Most of those mined today are from three to four feet in thickness. Veins less than two and a half feet thick cannot be mined with profit.

The mining of bituminous coal is fairly easy, because the veins are usually level or nearly so. The anthracite veins, on the other hand, are twisted and folded deep in the ground, making the coal harder to mine.

In most mines a shaft — that is, a vertical well — is cut deep down into the earth, probably for several hundred feet. Branching off from this shaft horizontal passages or chambers are hacked out wherever the layers of coal are found.

After the vertical shaft is dug a mine grows by the miners literally digging their way into the earth. From being small affairs at first — merely entrance ways from the main shaft — the passages slowly deepen and widen as more and more coal is dug out and hauled away. Only a few men are employed at first. As

the coal layers are scooped out long tunnels or passageways are formed. Soon there is room enough for more men. The mine grows slowly, then more rapidly as more and more miners are employed. It is usually several years before the mine is producing its largest amount.

It is absolutely dark down in the mine, of course, and the miners have to work by the light of little lamps which are

FIG. 71. How a coal mine would look if you could see into it. The black horizontal passageways show where the miners are at work digging out the coal. Notice that they follow the irregular course of the veins of coal. (Courtesy of the *Scientific American*)

attached to their caps. Before electric light was known, the lamps were oil torches. These torch flames were dangerous because of the coal gas in the mines, which was likely to catch fire. Today little electric lamps are used, which are safer and throw a steadier light. An engineer who worked as a coal-miner tells how completely the miner depends upon his lamp:

After you strap your little tin-covered battery to your belt, run the rubberized wire up your back, strapping it to the rear of your cap and then inserting the cute little electric lamp in the visor, you sort of forget it's there. So when you get into the . . . [elevator] cage . . . with the

other miners and drop down 120 feet suddenly—often with a feeling that your stomach is saying, "I don't quite follow you" — and start down the main passageway to your location, you forget that your tiny lamp is all there is between you and the densest blackness. . . .

Perhaps because you can't see your own lamp, you seem to forget that a mine is always dark — unutterably dark. You walk and you work always with things in view, or perhaps you take out a newspaper from your pocket; always you see it plainly. It wasn't until I was left alone that first morning for a half-hour and happened to take off my cap so that it fell face in on my coat, that I was fully aware of this. Then was a blackness! I thought I had suddenly gone blind—'til I recalled that, of course, I was in a mine, and 'twas my lamp that had been doing such noble service. As I hid my lamp again I found myself whistling or jiggling my leg. Why so? Well, because if I didn't make some noise or some motion, sitting there without seeing or feeling or hearing anything at all, I would begin to feel just as if I *wasn't there myself* — as though I was dead and gone and dried up and blown away.[1]

How is the coal dug?

The old-fashioned way is to use a hand pick. The miner hacks at the wall of coal before him, and the pieces that fall on the mine floor are lifted into little rail cars. These cars are then hauled away to the main shaft. There the coal is hoisted to the surface of the ground. Sometimes the miners hack out shelves or ledges under which explosives are set off, blasting down great lumps of coal. Sometimes holes are bored in the wall of coal with hand drills and explosives are set off in these for the same purpose.

More modern ways of mining make use of electric drilling machines equipped with teeth which bite into the coal. A man's brain is still necessary to guide the machine, but much more work can be done by a miner using a powerful drilling machine than by a miner wielding a hand pick.

The hardest work of all is loading the coal into the little cars. All the lifting has to be done by human muscles. The chambers are small and low, the roofs are uneven. There is not sufficient space to use steam shovels and other digging and lifting machines; so the miners themselves tug and heave at the blocks of coal.

[1] Adapted from Whiting Williams's *What's on the Worker's Mind* (Charles Scribner's Sons, New York, 1921).

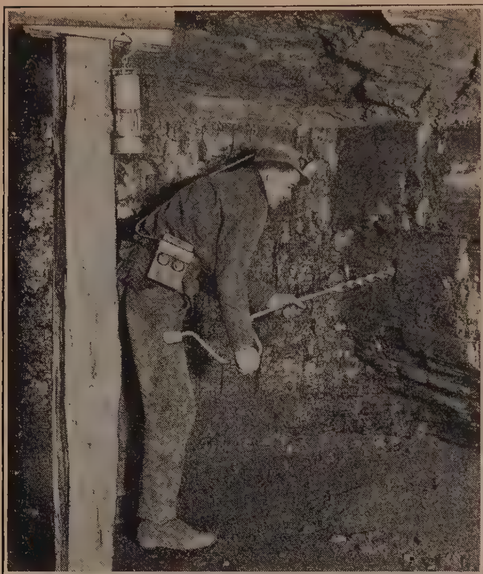


Fig. 72. A miner preparing a hole for blasting a layer of coal. Notice that wooden pillars are installed to hold up the roof of the chambers. The picture also shows the electric lamp which the man wears on his cap and the battery which runs it. Notice also that an electric lantern is hanging from the pillar

Thus we see that even today there are industries in which men have not learned how to substitute practicable machines for human muscles.

When the cars with their loads reach the mouth of the mine the coal is dumped and sorted. Then it is cleaned and broken up into various sizes, some of them small enough to be used in house stoves and furnaces. After the coal has been cleaned and sorted, it is dumped into railroad coal cars and shipped away to the places where it is to be used — to many homes and factories which depend upon it for heat and power. Figure 75 shows the arrival of coal in a city freight yard, from which it is distributed for use. Day and night, coal cars roll along bringing the mine's product to us.

Waste! Waste! Waste!

Every nation has wasted coal, but the United States, producer of half the world's coal supply, has been the worst spendthrift of all. Other people say of us that we are throwing away our most valuable fuel with "reckless prodigality." They call us "the Wasteful Nation," "the Prodigal Spenders," and like names. Are these names justified? They are. There are at least three ways in which we waste coal: first, we waste it in mining it; second, we waste it in burning it; third, we waste it in hauling it over the country.

1. Wastes in mining the coal

For every ton of coal that we mine we leave more than a ton untouched in the earth. With great difficulty our miners dig their way underground; yet they take away only half of the valuable coal that lies before them.

Now why do the owners of the coal mines leave half of the coal behind? Why don't they take it all? There are two reasons. In the first place, the coal is very uneven in quality: some is excellent coal, which can be sold at high prices; some is poorer coal; some is harder to get out and therefore more expensive, so that it cannot be sold at a profit. What do the coal-owners do? Of course they mine the good coal and the coal that is easy to get, leaving the rest and moving on to the places where they can find the better kinds. They carry this practice so far that often the lower layers of the coal, which are the best, are mined first, with the result that the poorer coal in the higher levels caves in, making it almost impossible ever to take it out.

In the second place, because of the great weight of earth above the mine it is sometimes necessary to leave much of the coal standing in the form of pillars which support the roof above the chambers. The newer method is finally to remove the pillars also. Then the mines are filled up with stone, earth, and debris of various kinds.

But there are other examples of waste in the coal industry. Some owners still employ old, out-of-date methods of mining instead of installing modern appliances. Thousands of tons of coal slack (that is, the very fine coal and dust) are thrown out on dumps each year and burned as useless material. Two savings could be accomplished here: first, the amount of this coal slack could be greatly reduced by careful methods of mining; second, practically all the slack could be profitably marketed if treated by new processes which render it useful as fuel.

2. Waste in burning coal

We are even more wasteful in the way we burn our coal than in the way we mine it. Consider the great amount of smoke made in burning coal. Smoke is waste. Think of the thousands of tons

of coal that are wasted each year in black smoke that goes up the chimneys. Pittsburgh, for example, is called "the smoky city," because thousands of chimneys there belch out black smoke 300 days in the year. In practically every industrial city in the country the same thing is true. Do you know what that black smoke is? Largely unburned carbon — an important part of the coal. If the coal is burned in the most efficient way, nearly all this carbon can be changed into heat and so into power.

It has been estimated that the carbon that is now lost in smoke every year is equal to 20,000,000 tons of coal. And in floating away in smoke not only is this carbon wasted but it also does a great deal of damage. It not only makes the hands, faces, clothes, and houses of people dirty and ugly but it affects the very health of people. After one has breathed smoke fumes a long time the body is weakened, and illness is invited.

The carbon wasted in smoke, therefore, means a great loss in health and comfort as well as in heat and power.

3. Waste in hauling coal from mine to factory

Perhaps the greatest waste of all is in the way we transport coal about the country. *One third of all the freight transported in America is coal.* Imagine it! A great railroad system like the Pennsylvania Lines "hauls 40,000 tons of coal each day, or nearly 15,000,000 tons a year, *for use as fuel on its locomotives.*" Remember that the Pennsylvania system, although very large (14,000 miles of tracks), represents only about one twentieth of the country's railroad mileage. Why is the transportation of coal so wasteful? Because for every 100 tons of coal shipped four tons of coal must be burned in the railroad locomotive in order to transport it.

Can this extravangance in hauling coal for locomotives be reduced? Yes, it can. Already engineers are devising plans by which some of the waste can be prevented. You will read in Chapter X of the proposals for the construction of great central power stations in different parts of the country. It is hoped that enough electric power can be made in these stations to run many of our trains as well as to turn the wheels of factories and to light cities.

The diagram of figure 73 lets us look at the problem of waste of coal squarely. Not so long ago, when this diagram was made, it was estimated that out of every 2000 pounds of coal only 76 pounds (about 4 per cent) were actually turned into useful work. More recent estimates of the engineers show that we are 10 per cent efficient. Ninety per cent of our coal resources are lost each year, and this after 100 years of advance in improving machines. This fact is of great importance to every one of us.

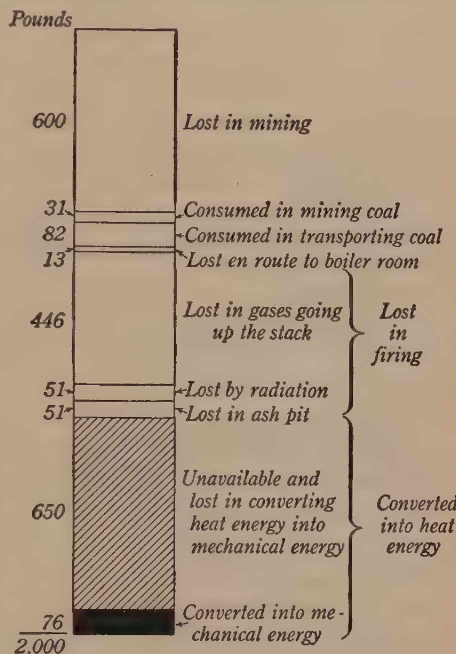


FIG. 73. This chart shows that the engineers estimated a few years ago that only 4 per cent of the energy in a ton of coal was actually converted into mechanical energy. The rest was waste[1]

How Long will our Coal Last?

While we still have great supplies of coal, we are using them at a tremendous rate. Some of our engineers have been much worried about our supply of fuel. They warn us that our whole civilization may change unless we do something to stop the waste of coal, and that we must prepare now for the time that will surely come when our coal supply is exhausted.

Do we really have to think seriously about this problem? Is it possible that the time actually *will* come when we shall no longer be able to get coal for heating our houses? Shall we go back to pioneer ways and use wood for this purpose? If the coal should be used up soon, what other fuel would supply the power for our locomotives, our factories, our street railways, and our electric-light plants?

[1] C. G. Gilbert and J. E. Pogue, *America's Power Resources: the Economic Significance of Coal, Oil, and Water Power.* The Century Co., New York, 1921.

Here is what one man said who recently studied the problem of waste:

> Up to this time we have used the fuel resources of our vast country . . . with no thought of tomorrow, no thought of those who are to come after us. The possibility of exhaustion of our fuel supply perhaps never entered our minds, and, if it did, we dismissed it with the remark that the American people are ingenious and inventive, and when the coal is exhausted we will draw heat from the sun or some other source. . . .
>
> Is there a possibility of exhausting the American coal mines? According to careful investigations and estimates the total amount of coal in the United States is approximately two trillion tons [the new estimate is four trillion tons]. . . . Such a majestic amount of coal seems inexhaustible. The Geological Survey estimated the consumption of coal in the United States, however, and found the rate of increase so enormous that, if it goes on, the coal beds will be practically exhausted within one hundred years.[1]

No wonder our experts are beginning to fear that our children's children will have to do without coal. We are using it up at a most amazing rate and each new year sees us using about 7 per cent more than the preceding year.

Here is another estimate from an expert, one of the chief engineers of the General Electric Company. He calculates that, if our coal consumption should continue to increase, the life of our known reserves would be as follows:

Eastern district, which includes the most easily mined and best quality of our fuel[2]	59 years
Eastern, central, and southern districts	65 years
Entire United States and Alaska, two thirds of this being low-grade coals and lignites	84 years

Now these figures include all the coal, the poor as well as the good, the coal that is hard to mine as well as the coal that is easy to mine. We must not forget that we have already taken out of the ground most of the coal that is easy to get. Each year in the future it will be harder and harder, more and more expensive to mine the coal, and that which we get will be of poorer quality.

[1] Adapted from Rudolph Cronau's *Our Wasteful Nation*, pp. 41–42. Copyright, Rudolph Cronau, 340 E. 198th St., New York City.

[2] Robert W. Bruere, *The Coming of Coal*. Association Press, New York, 1922.

These facts are important when we consider the stupendous increase in the production of coal in recent years. Note how clearly the facts are brought out in figure 74. In 1870 Great Britain was the only country which was producing large amounts of coal. In that year Germany exceeded the United States. In 1900, however, the production of coal in the United States equaled that of Great Britain and exceeded that of Germany. At that time our miners were working at a more feverish rate than at any other time. Factories were increasing by the thousand. Power was needed. Railroads were stretching over nearly 250,000 miles of tracks. More power was needed. Cities were growing, and power stations for making gas and electric light were multiplying. Still more power was needed! And while oil and water were contributing increasing amounts of power, yet the chief fuel was coal.

FIG. 74. These graphs show the amounts of coal produced by the leading industrial nations from 1870 to 1919. The height of the blackened area under any given year shows the amount produced. Note that the United States, Great Britain, and Germany are increasing very rapidly the amounts that they produce. The other countries, the production of which is shown on the graph, are increasing the mining of coal very slowly

Note in figure 74 what happened after 1900 in the United States. How suddenly the line of the graph sweeps upward — three hundred million tons of coal in 1900, then in 1910 about five hundred million tons and finally in 1919 nearly seven hundred million. Notice particularly how nearly vertical the line becomes after about 1914. More goods were manufactured than ever before, and coal kept the wheels of factories turning. It is easy to understand how dependent we are upon coal.

How can we Prolong our Coal Supply?

Because we are so dependent on coal, therefore, and because our supplies of this great power resource are limited and cannot be replaced, scientists and engineers have been trying to find a way of reducing waste. By using coal more efficiently it is hoped to prolong the time during which we and our descendants will

Fig. 75. Coal for America's homes and industries, the result of human labor aided by modern machinery. (Courtesy of the New York Central Railroad)

have coal. Which of the kinds of waste discussed in the foregoing pages can be reduced? First, it does not seem possible at the present time to change very much, even by our more modern methods, the way in which coal is mined. Some loss appears unavoidable in the mining of coal. We are, however, beginning to lessen the waste in the way we *use* our coal.

Coal is being used more effectively today by turning it into coke and other important by-products

Coal can be treated so that it can be turned into several valuable substances, such as gas, coal tar, crude oil, coke, etc. These additional products are called by-products. Three of the four substances mentioned can be used to do much more valuable work than the coal alone can do when burned directly to make power. Perhaps the most important of these is coke. A recent

estimate by engineers states that a ton (2000 pounds) of coal can be treated so as to produce:

1425 pounds of coke
10,500 cubic feet of gas
7.1 gallons of tar
2.4 gallons of crude oil
19 pounds of sulphate of ammonia

Coke is made by heating coal to an intense red-hot state in closed ovens, where no air can get at the coal directly. This heating process drives off some of the gases and leaves a slightly porous material, which is mostly carbon. This can be burned for fuel just as coal is burned.

Coke is a black, brittle substance which when burned for fuel gives off great heat and no smoke. In 1925 the United States produced 50,000,000 tons. Coke is a much more economical fuel than coal because of the additional products that are secured in making it. How much more one ton of coal might do for each of us than it does now is suggested by the mining engineers C. G. Gilbert and J. E. Pogue:

> It is not beyond the bounds of reason to foresee a condition whereby a householder, in place of his ton of anthracite, which he now welcomes for $11 [now nearly $17], will receive [nearly] a ton of smokeless fuel without slate [coke], a month's supply of cooking gas, 40 miles of motor fuel, enough fertilizer to start a small garden, and tar sufficient to allay the dust in front of his house — all for far less money than he now pays for inferior fuel. This may appear a fanciful picture, but coal has precisely this possibility within itself.[1]

Before 1900 coke was made in beehive ovens, so called because they were shaped like beehives. But these ovens were wasteful. They allowed substances to escape which contained many valuable products. Today we have better methods of making coke, which save such by-products as, for example, sulphate of ammonia, gas, crude oil, and coal tar. Of these none is more important than coal tar.

Coal tar can be converted into many things for the use of man. You know what it is — sticky, black, smelly stuff. It does not

[1] Adapted from C. G. Gilbert and J. E. Pogue's *America's Power Resources: the Economic Significance of Coal, Oil, and Water Power* (The Century Co., New York, 1921).

look as if it could be of any earthly use. Yet from it our scientists have learned how to make many other valuable by-products.

During the World War we were unable to get from other countries many things upon which we depended. One of our necessities was dyes for cloth. Until the war Germany supplied us with most of these. When trade with Germany was shut off the United States experimented with the manufacture of dyes. Our scientists discovered a way of making many excellent dyes from coal tar.

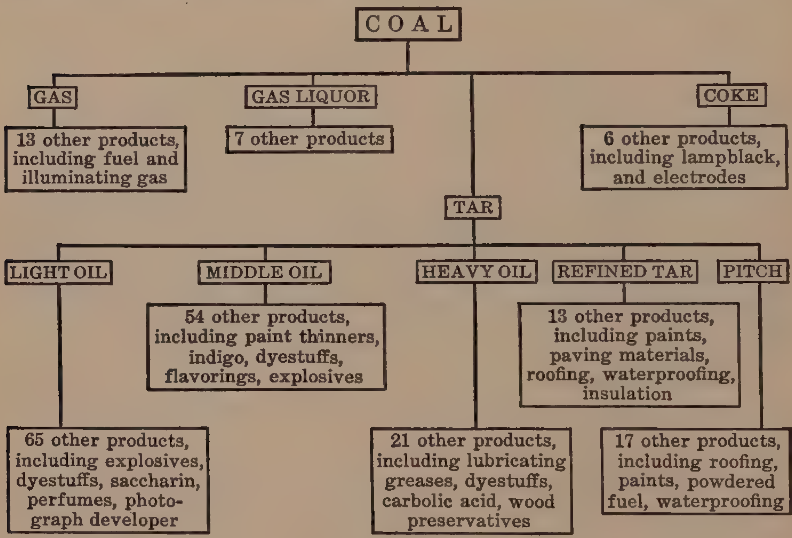


FIG. 76. Some of the by-products we obtain from a lump of coal. (Courtesy of the United States National Museum)

The war also forced us to manufacture great quantities of explosives. Again, our scientists found a method by which explosives could be made from coal tar. Many other valuable products were also produced from the once-despised coal tar: fertilizers, delicate perfumes and flavors, many drugs like novocaine (which deadens pain), medicines, and substances which are used in phonographs and radios. The list of important by-products that can be made from coal is long. We have mentioned only a few examples.

The examples which we have studied of making coke and other by-products from coal provide a further illustration of what

science can do for us. It was the scientific way of doing things that taught us how to make these by-products. To most of us coal is just coal. To a scientist, however, coal is an object that contains many different wonderful and valuable things. It is the business of the scientists and inventors to find out what these things are and how they can be made of service. We shall see as we study other industries that science plays an important part in all of them.

The Study of Coal and its Use in Modern Times: Conclusion

You have learned that for millions of years coal lay in the earth unused by men. Then, not so many hundred years ago, people living in different parts of the earth discovered that it would burn. They began to use it as fuel for heat and for cooking. When steam engines were invented it was found that coal could be burned under the boilers of engines to produce power. Other discoveries were made as to its usefulness. Since 1800 people in Europe and the United States have depended more and more upon coal. Thereafter they hunted for large supplies of it and tried to invent easy and cheap ways to mine it.

We saw that as the demand for it increased, people hurried to get coal out of the earth. Because of this, great amounts were wasted. There was waste in the way the coal was mined. There was waste in the way it was burned and waste in hauling from the mine to the factory. The past story of coal is, indeed, a story of waste. Then, about 1900, our statesmen and our engineers began to see that our supply of coal was being rapidly exhausted, and they did all that they could to conserve it. Scientists then began to devise ways of obtaining many by-products from it. So today, because we know that our coal supply cannot last forever, we are using it more efficiently. It is important that we continue to do so, for even with the best of care it will probably not last more than a few hundred years longer.

INTERESTING READINGS FROM WHICH YOU CAN GET ADDITIONAL INFORMATION

Books

BISHOP, A. F., and KELLER, A. G. Industry and Trade. Ginn and Company, Boston, 1923.

Chapter XIII (Coal and Petroleum) is a fairly good description of this industry.

FISHER, ELIZABETH F. Resources and Industries of the United States, pp. 142–154. Ginn and Company, Boston, 1919.

FRASER, CHELSEA C. Secrets of the Earth. Thomas Y. Crowell Company, New York, 1921.

A good book, describing the mining of coal. See Chapters I and II.

GREENE, HOMER. Coal and the Coal Mines. Houghton Mifflin Company, Boston, 1889.

An old book but gives a good description of the work in a coal mine.

*HUNTINGTON, ELLSWORTH, and CUSHING, SUMNER W. Modern Business Geography. World Book Company, Yonkers, New York, 1925.

This book presents a wealth of economic facts, illustrated by graphs and photographs. The best single geography. See Chapter IX (The Mining Industry) for material regarding coal.

HUSBAND, JOSEPH B. A Year in a Coal Mine. Houghton Mifflin Company, Boston, 1911.

A first-hand story of work in a mine.

*KAEMPFFERT, WALDEMAR B. (Editor). A Popular History of American Invention, Volume II. Charles Scribner's Sons, New York, 1924.

Part IV, Chapter IV (Buried Sunshine — the Story of Coal).

*KEIR, MALCOLM. The Epic of Industry (Volume V of The Pageant of America). Yale University Press, New Haven, 1926.

Chapter V (King Coal).

ROCHELEAU, W. F. Great American Industries, First Book (Minerals), pp. 7–44. A. Flanagan Company, Chicago, 1927.

A good account of coal mining.

TAPPAN, EVA MARCH. Diggers in the Earth, pp. 1–10. Houghton Mifflin Company. Boston, 1916.

An easily read story of how coal is mined.

**WILLIAMS, ARCHIBALD. The Romance of Modern Mining. J. B. Lippincott Company, Philadelphia, 1927.

Chapters VII and VIII contain vivid pictures of methods of mining coal and of the work of the coal miners.

Magazine Articles

*"Coal — Ally of American Industry," *National Geographic Magazine*, October, 1918, pp. 407–434.

An excellent article.

*"Uncle Sam — Spendthrift, II. Waste in Mining, Marketing, and Using of Coal, and the Remedy," *Scientific American*, October, 1926, pp. 270–271.

CHAPTER IX

OIL: MAGIC POWER AND WEALTH

"Oil is Struck in Persia!" "New Discovery of Oil in Oklahoma!" "Oil-Gusher Spouts in Texas!" "Rumania Excited over Discovery of New Oil Well!" "Mexican Oil Supply Increasing!" Newspaper headlines like these greet us constantly these days

DRILLS AWHIRLING IN A RACE FOR OIL

SHAWNEE, Okla., Nov. 15 (A.P.) — Nearly 100 whirling drills were tearing through the surface of the earth tonight in the Maud and Mission pools of the greater Seminole Oil area in a race for "black gold."

Temporary communities of tents and rough shacks sprang up almost overnight as an army of field workers moved in to man the drilling machinery. It was estimated that the newcomers, including workers and their families, numbered approximately 10,000.[1]

announcing that new deposits of petroleum (or oil, as it is commonly called) have been found in various parts of the earth. All over the world a scramble for oil is on.

Why so much excitement about oil? Because it is the second great source of power and because modern industry is becoming increasingly dependent upon it. There are oil-burning boats on the oceans, oil heaters in our homes, oil in the form of gasoline for our motor cars. There are oil-burning engines which do our work and furnish power for machines. Oil greases the wheels of machines and engines and keeps them turning smoothly. Wonderful and mysterious as was the story of coal, the romance of oil is just as thrilling.

A hundred years ago oil was rarely used and no engine had been invented to utilize its power. But even then men used wheels —

[1] From the New York *World*, November 16, 1928.

wagon wheels, water wheels, windmills. Wherever there were turning wheels, oil was needed to lubricate them. In those days people used whale oil, but it was already becoming hard to get. From New England ports small ships and hardy crews set out on long whaling voyages to collect the oil that was needed to grease the wheels and the simple tools used on farms and in shops. After an absence of months or even years, the ships returned with great casks of oil, obtained from the blubber, or fat, of the whale. This was worth a fortune. But the dangers and hardships of the trips were so great that the ship captains had a hard time mustering enough men for the cruise. So, when, in 1859 another kind of oil was found pouring from the ground like water from a spring — an oil that would serve as well as whale oil for light and heat and lubricant — it was sought by men with all the eagerness that gold is sought. It meant wealth.

The Story of Petroleum in North America: from Indian Medicine to World Fuel.

When the white settlers first came to this country they learned that the Indians used as a medicine an oily scum found on certain lakes and in springs. Some of the thrifty New Englanders began skimming the pools, bottling the oil, and offering it for sale. It is said that some of George Washington's soldiers, rubbing their tired limbs with oil from neighboring springs, were much refreshed. Oil from such sources, however, could only be obtained with difficulty and in small quantities. Moreover, there was little demand for it.

The real story of oil in the United States begins with the attempts of the settlers who lived far from the seacoast to obtain *salt*! Finding that certain springs and pools were visited more often than others by animals and Indians, they were curious to know the reason. They tasted the water and found it salty. By evaporating the water from these springs they obtained their salt. But a *black, oily substance* was often found mixed with it, making it much less desirable. Petroleum!

As the colonists increased in number the little pools were unable to supply the demand for salt, and a new plan to obtain it was

tried. Just as people drilled wells for fresh water, so now the salt-makers drilled wells for salt water. They were annoyed to find, however, that the deeper they drilled the greater was the amount of oil found mixed with the salty water. One salt-maker, Martin Beatty, struck a lake of oil instead of a salt pool, which he had expected to find. He allowed it to flow into the Cumberland River, where it covered the surface of the water for 35 miles. The sheet of oil floating on the water caught fire, and the astonished settlers, seeing what appeared to be a blazing river, called this inflammable oil "devil's tar."

FIG. 77. People knew about oil in Europe hundreds of years ago. This picture is from an old book. It shows that as long ago as 1556 oil was collected from springs[1]

Oil was known in Asia long before its discovery in North America. The Persians knew two thousand years ago of pools of oil lying near the Caspian Sea. But oil then had no commercial value; people did not know how to use it. It was also known in Europe long ago, as figure 77 shows. In England a well was struck over 100 years ago, which is still pouring out its oil.

While the salt-makers of America were worrying over the oil in their product, experiments were going on in England and France to find a way of using oil for lighting. The news drifted over to America and finally came to a Pittsburgh druggist, named Samuel Kier, who had been vainly trying to sell oil as a medicine under its old Indian name, "Seneca Oil." Kier's experiments were somewhat more successful than those of the English and French, and petroleum began to replace whale oil for lighting lamps and lubricating wheels. Men began to see that there was wealth to be had from petroleum if only it could be found in large quantities. They never dreamed, however, of the important place it was to fill.

[1] From Georgius Agricola's *De Re Metallica*, 1556.

Edwin L. Drake "strikes oil," 1859

Years went by. Then on August 27, 1859, "Colonel" E. L. Drake, a New England railroad conductor, struck oil near Titusville, Pennsylvania. For weeks Drake, who had been drilling for oil in that region, had been called a harebrained fool. The whole countryside had ridiculed him as week after week, in spite of one disappointment after another, he had drilled deep wells into the ground in his search for oil. One Saturday afternoon his laborers lost their drill in the well. They withdrew their tools from the hole and went home. On the next day curious Sunday visitors, looking into the hole, discovered oil rising within a few feet of the top. The news was sent to Drake, a pump was installed, and the first day 25 barrels of oil were drawn from the well.

FIG. 78. This is "Drake's folly." Here, August 27, 1859, "Colonel" E. L. Drake struck oil. This was the site of the first "oil boom" town. (Courtesy of Doubleday, Doran & Company, Inc., New York)

Almost at once Drake became the hero of the country. Word was flashed over the telegraph wires throughout the United States that fortunes were to be had by simply drilling holes in Pennsylvania farms. Crowds came to see Drake's well and to buy land near it. Many new wells were drilled. Some were dry; others flowed at the low rate of 25 barrels a day. Wells were sunk deeper and deeper, and oil began to flow in larger and larger amounts. In June, 1861, one of these deep wells poured forth oil at the rate of 300 barrels a day. For a year and a quarter it

continued to give out its oily liquid. As the engineers learned how to drill deeper, as hundreds of people tapped the new pools, the streams rushing from the wells rose to greater and greater quantities: 3000 barrels, 4000 barrels, even 5000 barrels, in a single day!

Before 1859, people in Oil Creek valley in Pennsylvania had worked very hard to get a meager living by lumbering and farming. By 1865 the whole region was made over. It was the busy center of a new industry. Almost every acre boasted its oil well. Farms previously worth less than one dollar an *acre* sold for thousands of dollars a *square foot*. One "boom" town after another sprang up. Thousands of companies were formed, and stock in these companies was offered for sale all over the country. Cooks and chambermaids and laboring men invested their savings. Everyone took a chance on this new "get-rich-quick" scheme. When oil was struck, fortunes were made; when oil was not found, some of the unfortunates lost everything they had. The experiences of these seekers for "liquid gold" have been well told in George Fitch's humorous account of the way an oil well is drilled:

> An oil well is a hole in the ground about a quarter of a mile deep, into which a man may put a small fortune or out of which he may take a big one. And he never knows until the hole is finished. It takes a couple of thousand dollars, several months, and a couple of men in mud-plastered overalls to dig an oil well. They begin by going up about 60 feet. When they have finished their derrick, they hang a drill on it weighing half a ton. Then the men hitch the drill to an engine and punch a 42-centimeter hole in the earth's crust. Sometimes after they have been punching away for several weeks, the hole blows the derrick into the sky, utterly ruining it. Then the owner shrieks with glee and employs 500 men to catch the spouting oil in barrels. But sometimes the derrick is as good as new when the hole is finished. Then the owner curses and takes the derrick away to some other place which smells oily.

Does the United States depend upon Other Regions for Oil?

Since 1860 the increase in the production of oil has been almost unbelievable:

1859, about 25 barrels a day
1925, about 3,000,000 barrels a day

FIG. 79. What countries are now producing oil?

Between the years 1859 and 1925 people in different parts of the world have taken from the earth a total of more than 7,000,000,000 barrels of oil. The darkened circles on the map of figure 79 show you where this oil comes from. The graph at the left shows how the production has increased even since 1900. The next graph in figure 79 shows you where most of the oil was produced in a recent year.

Not only has there been a startling increase in the world production of oil, but there has been an amazing increase in production in the United States. Figure 80 shows how great has been the increase in our own country during the period from 1860 to 1925. Furthermore, figure 79 tells you that the United States produces a far greater amount than any country in the world — indeed, more than four times as much as any *one country*. For example, the Mexican oil production is large, but that of our country is more than seven times as great. In southern Russia and in Persia there is much oil, but the wells of the United States pour out more than ten times as much each year as either of these.

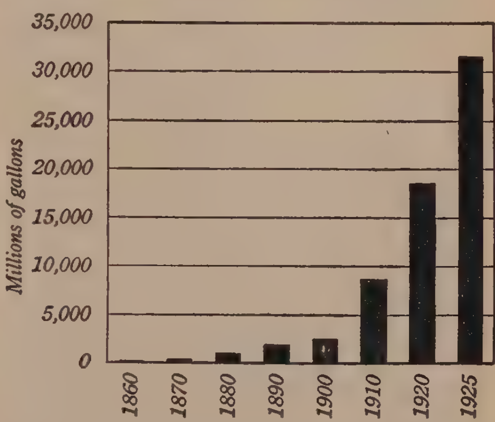


FIG. 80. The startling increase in the amount of petroleum produced in the United States from 1860 to 1925

Figure 79 helps to answer another question: Do we produce enough oil to satisfy our own needs? That question can be answered by knowing whether we buy oil from other countries. The right-hand graph of figure 79 shows that we do; but it also shows that in 1924 and 1925 we sold to other countries more oil than we bought from them. The graph proves that although our need for oil to supply power for our engines is gigantic, nevertheless we are still able to produce within our own borders all that we need.

The Location of the Oil Fields of the United States

What region in our country produces this tremendous volume of oil? In 1859 it was Pennsylvania, but in the past 70 years the Pennsylvania fields and other fields close by have been very much exhausted. Today it is the southern California field and the mid-continent field (Texas, Oklahoma, and Kansas) which produce the largest amounts. This is shown on the map of

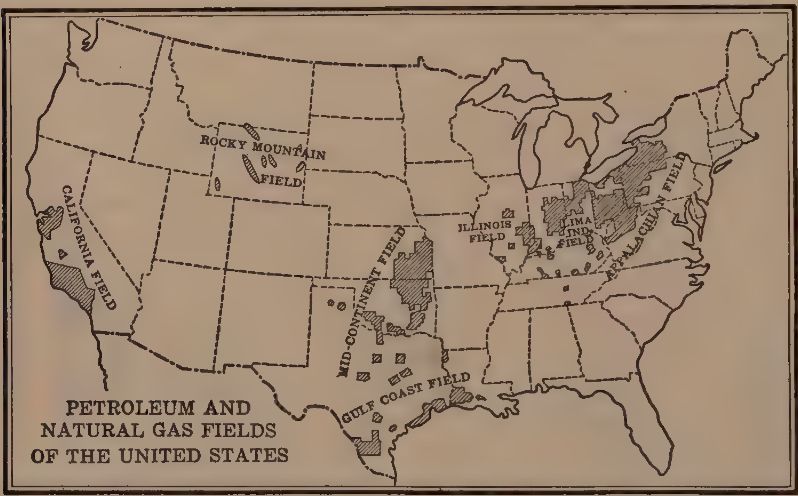


Fig. 81. This map shows the seven chief petroleum and natural-gas fields of the United States[1]

figure 79 as well as on that of figure 81. Note in figure 79 that the largest shaded circle in the United States is that which surrounds Los Angeles and southern California, and that the second largest is that in Oklahoma, Texas, and Kansas. In addition to these two great fields, large amounts are now obtained from the Gulf Coast field in Texas, from the Rocky Mountain field, from the Illinois field, and from the Lima-Indiana field. It is safe to say that in recent years more than three fourths of our oil has been produced in three fields — the mid-continent, California, and Gulf Coast. The search for new oil fields in the United States still goes on, for there is an ever-increasing demand for oil.

[1] F. G. Baum, *Atlas of U.S.A. Electric Power Industry.* McGraw-Hill Book Company, Inc., New York, 1923.

Why This Astonishing Production of Oil?

Several reasons account for the great increase in the production of oil. But the greatest of these is the invention of the gas engine. The graph of figure 80 shows that in the United States from 1860 to 1900 only relatively small amounts of oil were produced. But in these years only relatively small amounts of power were needed. During these very years, however, the gas engine was being perfected, and after 1890 it was applied successfully to the automobile, then to agricultural machines, and to airplanes and airships. So rapidly did it come into use that in 1927 there were millions of motor cars and trucks in the United States, each equipped with a gas engine. The power which drives our automobiles, tractors, airplanes, and airships is obtained from gas engines, and the fuel which they use is *gasoline*, made from petroleum.

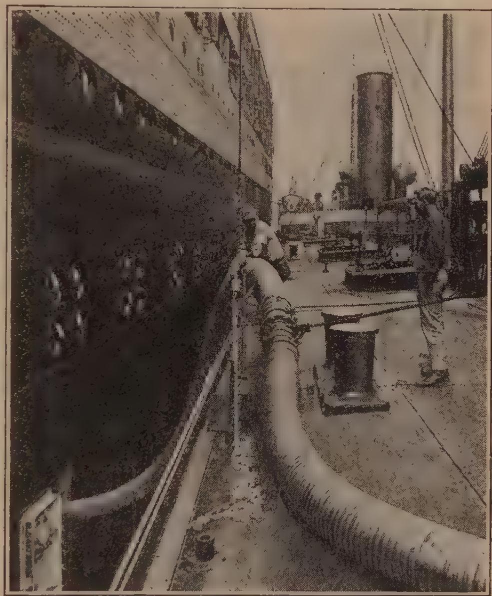


Fig. 82. Filling a modern ocean liner with petroleum used for fuel. What a saving in labor over the ancient method of filling the ship's bunkers with coal! (Courtesy of the American Petroleum Institute)

The invention of the gas engine alone, therefore, accounts for much of the recent increase in the production of oil. But there are other important reasons. Perhaps the next in importance is the substitution of oil for coal as fuel in other kinds of engines. In the past ten years manufacturers in many industries have begun to use oil-burning engines in their factories. Even householders are learning to heat their houses with oil-burning furnaces. Some of the railroads are burning oil instead of coal under the boilers of their locomotives. Some of our transatlantic liners are being

propelled by oil-burning engines. Great advertising campaigns have been put on by the oil companies to persuade ocean-steamship companies to use oil instead of coal. Arguments like these, for example, are made to British and American shippers: "Three-and-a-half barrels of fuel oil can do the work of one ton of coal. You can buy oil from 30 to 60 cents a barrel, while coal costs from $7 a ton up."

The British navy has adopted oil as fuel for its vessels. Although in 1924 only 45 per cent of the naval ships of Great Britain were using oil, now more than 90 per cent are doing so. Even though it takes less oil than coal to run a great ocean liner, these huge steamships consume startling quantities of oil. The *Leviathan*, for example, in one round trip to Europe used 68,000 barrels of oil!

Transporting Oil from the Wells to the Refineries

The seven great oil fields of the United States lie scattered in remote sections of the country. More than 1500 miles separate the chief oil-producing fields from the industrial section where most of the oil is refined and used. How is the tremendous quantity of oil derived from these fields shipped over such great distances? Is it done by wagon, or by truck and railroad? Seventy years ago it was shipped by all these means. Oil was barreled at the wells and sent by team and railroad to the manufacturing centers. The barrels had to be loaded and unloaded, and that was wasteful of money. The railroads, furthermore, sometimes charged high freight rates. So even in the 1860's the oil-producers tried to find cheaper and more satisfactory ways of transporting oil.

They found the solution of their problem to be astonishingly simple — they sent it through pipes, of course! Oil is fluid, like water, and can be pumped great distances through pipes. As early as 1865 oil was successfully pumped through short trial pipe lines. A few years later pipe lines several hundred miles in length had been built from the oil fields in western Pennsylvania up over the Appalachian Mountains and down to the ports on the Atlantic coast. Pumping stations were established every few miles to keep the oil moving. As more and more wells were drilled and other oil fields opened in different parts of the country the length of the

pipe lines increased. Today a perfect network of them joins the Texas and Oklahoma fields with Chicago and other cities on the Great Lakes, and with port cities on the Gulf of Mexico and along the North Atlantic coast. Day and night oil is pumped through these pipes. In a steady stream it pours into great storage tanks hundreds of miles away from the wells which produce it.

There is a story about a Missouri farmer that illustrates one of the difficulties that the oil men encountered. About the time the pipe lines were first introduced into the southwest field this farmer went out one day to plow. Just as he turned over the first furrow of earth his ears were greeted with a blood-curdling shriek of protest. The sound seemed to come from the ground about a rod to his right, and to be progressing precisely in his direction. Our farmer friend did not wait to learn whether the disturbance was caused by an earthquake or by some underground demon, but simply took to his heels and ran for dear life. Breathless and terrified, he explained his experience to the first neighbor he met, who was heartless enough to laugh uproariously.

"That's the 'go-devil' making his trip down to the pumping station below town," explained the unsympathetic neighbor.

"I thought it was the devil," gasped the frightened farmer; "but what's he doing in my field?"

Further explanations quickly followed. Across the rear of the field ran the main trunk line of one of the great pipes conveying petroleum from Oklahoma and Kansas to the Eastern refineries — plants where oil is prepared for use in various ways. Every two or three weeks the big pipe gets gummed up with oil and the "go-devil" is slipped into the pipe at one of the pumping stations, to be swept along by the current of oil to the next pumping station, some 40 miles away. The go-devil is a contraption of knives and disks, which scrapes the accumulated sediment off the inside of the pipe and keeps it from clogging. As it moves along the go-devil occasionally gives out terrifying screeches.[1]

This great pipe-line system is called the "underground railroad" of the United States. If all the petroleum which moves through these pipe lines in a year were loaded in barrels or in

[1] This story was adapted from data supplied by the courtesy of the American Petroleum Institute, New York City.

oil-tank cars to be hauled by railroads, it would make up a train 40,000 miles long, which would stretch once around the earth and two thirds of the way around it again. Yet this enormous tonnage is moved so quietly and invisibly under the ground that most people know nothing about it. The oil pipe lines are the cheapest of transportation systems. The pipe-line cost of transporting oil ranges from four to ten cents a mile for 100 barrels. That is only

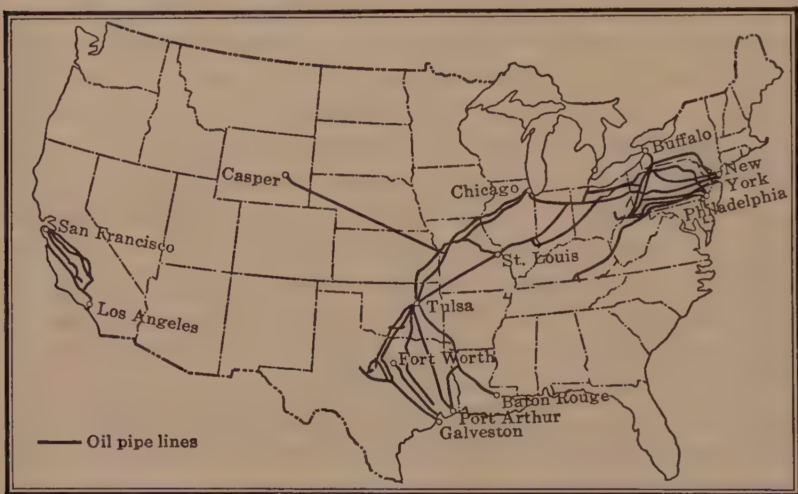


FIG. 83. The mysterious "underground railroad" system of the United States. Underground pipes 85,000 miles in length carry the product of the oil fields of the United States to distant cities where it is used or from which it is shipped to other countries. (Courtesy of the American Petroleum Institute)

about 10 per cent of the cost of rail transportation. The low cost of transportation is largely due to the fact that nothing except the oil itself is moved. To haul 50 tons of coal it is necessary to haul also cars weighing 20 tons. There is no such waste in pipe-line movement of oil.

HOW LONG WILL OUR OIL SUPPLY LAST?

Many illustrations have shown us that the new civilization in which we live depends upon mechanical power; that is, upon coal, oil, and water. (How great amounts of electric power are made by water wheels is discussed in the next chapter.) The preceding pages, therefore, have proved our dependence upon coal and oil.

We learned that the coal supply of the United States, though it is disappearing rapidly, may last several hundred years. Is this true of our supplies of oil? How long will they last?

The United States Geological Survey estimated in 1925 that there were in all the oil fields of the United States not more than 9,000,000,000 barrels of oil which could be profitably taken from the earth. Think of 9,000,000,000 barrels! Is not this to be regarded as a very large supply? Will it not last a very long time?

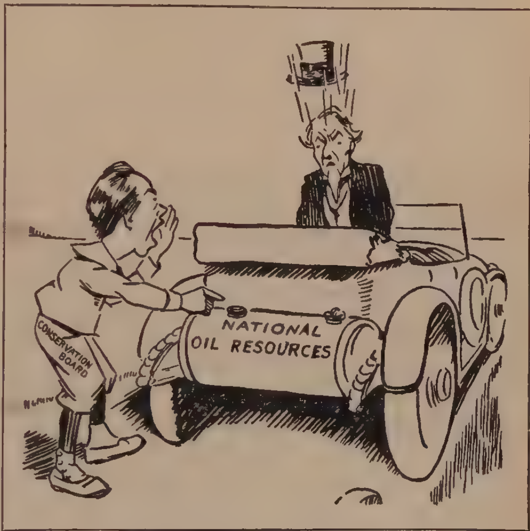


FIG. 84. The cartoonist imagines that conservation experts are saying to Uncle Sam: "Hey, Unk! We can only go six miles more." What is the point of the cartoon? (Courtesy of the *New York Times*)

The engineers assure us that it will not. First, every year we are extracting a huge quantity of oil from the earth. In 1925 more than 750,000,000 barrels were extracted in the United States alone—that is, approximately one twelfth of the estimated amount which is now in the United States. Second, each year we are using about 15 per cent more oil than we used the year before. Third, the oil wells that we drill today are not nearly so successful as they have been in recent years. For example, from 1908 to 1913 one sixth of the wells that were drilled had no oil; from 1913 to 1918 one fifth had no oil; from 1918 to 1923 nearly one fourth had no oil. In each of these five-year periods an increasing proportion of the wells were dry. Thus we see not only that we are exhausting our oil supply at a tremendous rate, but also that a smaller proportion of the wells we drill produce oil. Hence our oil men, our engineers, our manufacturers, and shippers — indeed, all of us in the United States are concerned with the great question of the oil supply. Experts estimate that if we

continue to use the oil at the increasing rate of the past few years the supply will be gone within the lifetime of those who are now in school. Some engineers estimate that it may last only fifteen years; some say thirty years.

Will new deposits of oil be formed in our time?

When the oil is gone where are we to get more? Will the oil deposits which we are emptying be replaced? Assuming that the engineers have discovered all the deposits now in the earth, will new ones be formed in our lifetime? The story of how oil was formed in the earth will help you to answer this question.

FIG. 85. This picture has been drawn by experts in the United States National Museum to show the way in which oil, gas, and water occur one above the other in the ground. The heavy black stripes show pools of oil. The white pockets below them are water. At the left of the picture is shown one small deposit of gas lying above a deposit of oil. With the oil deposits natural gas is found. (Courtesy of the United States National Museum)

There is as much uncertainty about the formation of oil as there is about the formation of coal. Scientists believe, however, that the two went on together and in much the same way. They believe that lakes of oil which now exist under the surface of the earth were formed from huge ocean beds of decayed material. Ages and ages ago the ocean bed was covered with slime, seaweed, and the remains of fish. During various upheavals of the earth the ocean bed was violently displaced, and it is believed that at these times millions of fish were destroyed. Their remains were buried underneath layers of earth along with plants and other kinds of sediment. Many scientists think, therefore, that these masses of decaying seaweed, plants, and animals slowly formed into liquid and became our underground deposits of petroleum. Nobody

knows how many millions of years this petroleum has lain in pools and in porous rock under hard-packed earth, rock, and coal.

It is clear, therefore, that new oil will not be formed quickly enough in the earth to give us a fresh supply. Not for millions of years can that happen.

How can our Oil Supply be Conserved?

1. We can reduce the wastes of production

Waste! Waste! Waste! The story of oil production since 1900 reveals even more distressing examples of waste than that of the production of coal. There has been great waste in the taking

© Ewing Galloway

Fig. 86. Goose Creek oil field, Texas, one of the richest oil deposits in the world. This land is owned by several people. Each is drilling for dear life to beat his neighbors in the race to get the oil out first

of the oil from the ground and also, until recent years, in our use of it. Undoubtedly the most glaring form of waste occurs at the oil well itself.

The very fact that oil is fluid, lying in great lakelike formations deep underground, accounts for the most serious of all the wastes of oil. Note in figure 86 the two lines of oil wells on opposite sides of the little stream. This land has several different owners. The

well of each owner can draw oil away from the oil underneath another owner's land. There is no way by which partitions can be made in the underground lakes of oil. The case would be similar to that of trying to partition acres of a lake of water. You know how foolish it would be to say: "I'll take all the water from this acre and you take it from that acre." As you drew up the water from your acre the space would be immediately filled in from the neighboring parts of the lake; or your water would run into the other fellow's acre if he pumped out of his faster than you pumped out of yours. So it is with oil. Each person who drills into an oil pocket takes away from others who are drawing oil out of the same pocket.

FIG. 87. What problem is the cartoonist trying to present? "Producer" means the owners of oil wells. "Intensive drilling" refers to the extravagant drilling of wells all over the country. Why is the producer in danger as he skates toward the hole in the ice marked "overproduction"? (Courtesy of the American Petroleum Institute)

So you can see why owners of oil wells all over the United States are drilling for dear life, trying to get out all the oil they can as quickly as they can. Each owner is pumping all the oil that he can, even though neither he nor anyone else needs it at that moment. If you flew in an airplane over a certain part of Texas today you would see 1100 wells in one small section 30 miles wide and 120 miles long. In the California fields, in the Oklahoma fields, indeed all over the country, there is a mad race to extract as much oil from the ground as possible.

Not only is there a great waste at present in the overproduction of oil (see figure 87), but enormous wastes have also occurred and

still occur in gushers and in the extravagant "shooting" of wells. First, a word about the gushers. When a hole is drilled into an oil lake, the pressure existing in the earth may drive up the oil with mighty force, producing a great spouting fountain. In spite of the care which oil engineers take to provide storage tanks for the outrushing oils, these are often not large enough to hold it all, and great quantities are wasted.

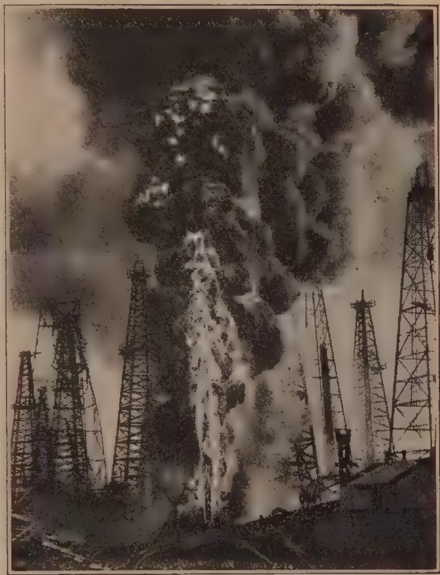


FIG. 88. Waste! Waste! Waste! An oil field afire in southern Texas. (Courtesy of the United States Bureau of Mines, Washington, D.C.)

Sometimes these gushers occur naturally as the well is driven into the oil pocket. At other times, when no gusher is found, the oil-owners, in their eagerness to get the oil quickly, produce great waste by "shooting" the wells. This is done by dropping a torpedo of nitroglycerin into the well and exploding it. If the explosion is successful in reaching clear down to the pocket of oil, an enormous column of gas and oil rushes up the pipe. In the early days of the oil industry, immense amounts were allowed to run out onto the land. Cases have been known in which vast amounts were burned in order to get rid of them. Nowadays, however, some of the waste is prevented by arranging storage tanks to receive the oil. Nevertheless, the waste due to this cause is still very great indeed.

The picture of figure 88 illustrates another important form of waste: oil-field fires. Altogether too frequently oil wells, even storage tanks, catch fire and burn for days and days. Tens of thousands of dollars' worth of valuable oil go up in smoke.

Finally, in spite of the modern methods of drilling and pumping oil with powerful engines, engineers succeed in removing only about half of the oil that is deposited in the earth. Nowadays

wells are driven down many hundreds of feet below the surface of the earth. Great pumps are required to force the oil to the surface. In spite of the power of these modern appliances, however, they are unable to pump up all the oil; approximately half of it is left in the ground, probably never to be of use to man.

2. We can reduce waste by using the by-products of oil

Petroleum is of little use in the form in which it is taken from the earth. It can, however, be treated and separated into gasoline and other products which can be used in engines, lamps, furnaces, etc. This process of treating raw petroleum is called "refining." It consists of the following steps: First, the petroleum is heated in a great tank to the temperature at which one of the products contained in the petroleum will begin to rise in the form of vapor. Second, the vapor which rises passes through pipes which are cooled. The vapor condenses into liquid which flows down into another tank and forms one of these by-products. Third, the tank containing the remaining petroleum is heated to a higher temperature. Under this higher heat, another product within the petroleum is changed into vapor and is drawn off and condensed as before. Another useful by-product is thus formed. The process of heating the original tank of petroleum to higher and higher temperatures continues until all of the products in the petroleum have been transformed into vapor, then into liquids, and have been stored in additional tanks. Finally, particles of paraffin appear in the black, tarlike mass that is left in the petroleum tank after the many by-products have been secured. When these particles have been taken off there remains a heavy, black, tarlike sediment. This is the *fuel oil* which is used to run ships and locomotives and to heat buildings.

Petroleum, when refined, therefore, is separated into several useful products (see figure 89): (1) Approximately half becomes fuel and gas oil, which is used in the engines of ships and factories. (2) One fourth becomes gasoline, which runs the engines of automobiles, tractors, airplanes, etc. (3) One tenth becomes kerosene, used in lamps, stoves, etc. (4) Four per cent becomes lubricating oil. (5) Two per cent is separated into wax, coke, and asphalt.

(6) About 6 per cent of it is turned into paraffin, mineral oil, petroleum jelly, and other products.

In spite of the increased efficiency in treating petroleum, about 4 per cent of it is lost.

It is clear, therefore, that today great savings are being made by those refiners of petroleum who get out all the useful by-products in the petroleum. In early days, as you have learned,

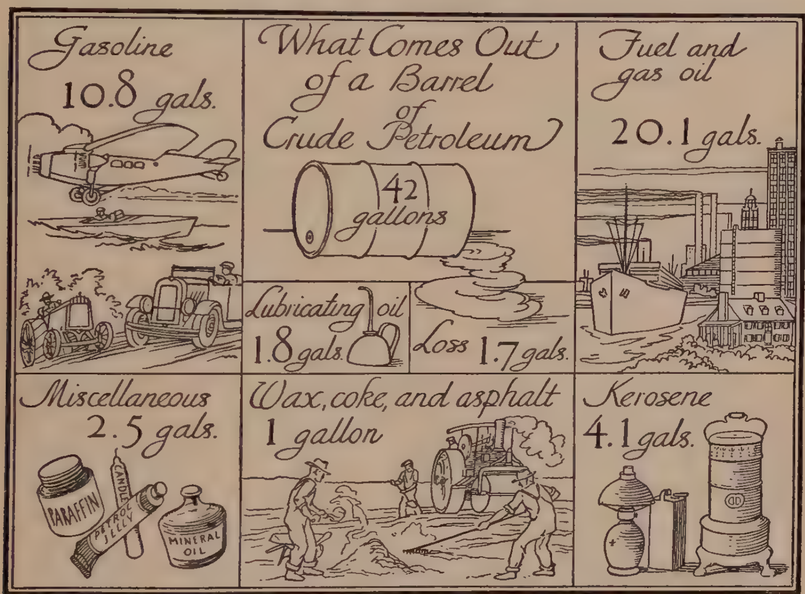


FIG. 89

kerosene was the only by-product known. Even today, however, many of the small refineries, known as "skimming stations," are very wasteful. They remove only the gasoline and kerosene and sell all the rest as fuel oil. The drawings of figure 89 remind us that this means a loss of between 10 and 15 per cent of the additional by-products that could be obtained from the petroleum. In recent years scientists have discovered how to make more than 200 articles from the products into which petroleum can be separated. Only a few of these are indicated in figure 89. Another interesting product is the fine lubricating oil which is used for delicate instruments. So valuable is this that it has been sold at as high a price as $38,000 a barrel.

In Summary, then, Oil is Both Magic Power and Magic Wealth

Oil — magic power? Yes, it can truly be called that. Not so long ago, however, people had little use for it; they spilled it out into rivers and burned it to get rid of it. Suddenly, however, almost overnight, there came the invention of gas engines; and within a few decades oil became our second most important power resource.

The power contained in one of the by-products of petroleum — gasoline — propels most of the 23,000,000 automobiles of the United States. The power of another of its by-products — fuel oil — propels great vessels. It also furnishes the power for some of the locomotives on our railroads and some of the engines in our factories.

Oil — magic wealth? Yes. At first known merely as a greasy substance ruining the taste of salt, it was suddenly found to contain many valuable substances, — not only gasoline and lubricating oil but fuel and gas oil, kerosene, naphtha, paraffin, wax, asphalt, mineral oil, and 200 others. From being a nuisance, oil has become a necessity; from being a source of annoyance, it has become a great source of wealth.

INTERESTING READINGS FROM WHICH YOU CAN GET ADDITIONAL INFORMATION

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*Keir, Malcolm. The Epic of Industry (Volume V of The Pageant of America). Yale University Press, New Haven, 1926.

Chapter VI (Tapping the Oil Pools).

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CHAPTER X

HARNESSING THE POWER IN THE STREAMS OF THE UNITED STATES

There is power in coal. There is power in oil. There is also power in flowing water. In the order of their importance we are studying our three great sources of power. Coal is most important, oil is second, and water is third. In this chapter we shall study how men have used the power in streams of moving water.

Throughout history men have tried to make water do their work. You have read how the direct force of flowing streams was used to turn the crude, flat paddles of mill wheels. When inventors in the early 1800's tried to make better water wheels the result was wheels which looked a good deal like that shown in figure 90. As the water fell upon the paddles of the wheel, great quantities splashed to one side without helping much to turn the wheel. This wasted much of the power contained in the streams.

A method was therefore needed of obtaining more of the power contained in flowing water. Moreover, there was another need to be satisfied. Men not only wanted more power, but they wanted to be able to use it at greater distances from the stream.

The problem of inventing more efficient water wheels was solved by Lester A. Pelton. In 1850 Pelton was prospecting for gold in California. While engaged in mining he observed men using streams of water from hose to wash out large holes in the earth. The great force with which the water rushed from the hose and the huge holes it was able to make gave Pelton the hint from which he invented a very efficient water wheel. He arranged to have the water shot through a large iron pipe to the end of which was attached a nozzle. From a reservoir high up above the wheel the water dropped upon the wheel with great force through this pipe. Pelton later designed a more efficient wheel, one made of metal, which was a great improvement over the wooden wheels. He curved its paddles so that they formed great cups. Notice

these cups in figure 91. The water rushing through the nozzle at the end of the pipe hit the cuplike paddles with terrific force and turned the wheels much faster than water wheels had ever been turned before. Practically all the force of the water was used to turn them. Improvement after improvement was made on the Pelton water wheel, and so efficient is it that it is being used to this day.

© Keystone View Co.

FIG. 90. A crude water wheel turning under the force of water shot against it from a pipe. Notice that most of the water splashes over the side of the wheel; hence much of its force is wasted. Compare this figure with figure 91

The second problem, that of using water power some distance away from the stream, was solved in this way. You learned in Chapter VI how the power in wind and water was used to grind grain. The wind wheel or water wheel was attached to a rod or shaft inside the mill. At the end of the shaft were grinding-stones. Men learned that if a second wheel were fastened to the end of the shaft where they

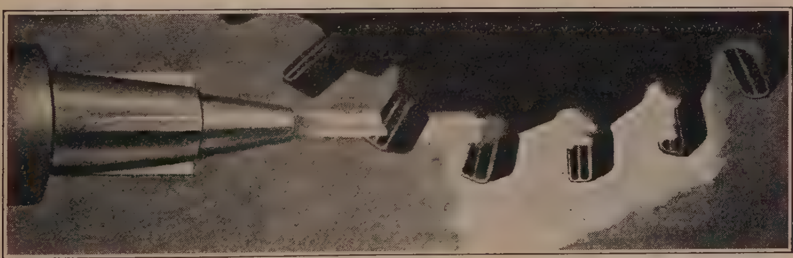

FIG. 91. This is a modern Pelton water wheel. (Courtesy of the Pelton Water Wheel Company)

used to attach the grinding-stones, a belt could be placed over this second wheel connecting it with a shaft of machinery. The machinery could then be set at some distance from the stream. The turning shaft would turn the belt, which, when connected with machinery, would put it in motion.

These two devices — the efficient water wheel and the use of belts to send power short distances — were great improvements in the use of water power.

Water Power can be sent Great Distances in the Form of Electricity

Even with the improvements just described, the power obtained from water wheels could be used only near the bank of the stream. For many years, therefore, factories were built close to waterfalls or swift-flowing rivers. Men had not learned how to make electrical power and send it over wires to distant places. Then came the invention of the electrical generator, of which you read in Chapter VII. Shortly after, Thomas Edison and other inventors devised a way of using these generators to send small quantities of electrical power over wires to light lamps and to drive machines miles away. One improvement followed another, each one making it possible to send larger amounts of electrical power over longer and longer distances. By using water wheels, therefore, to make electricity in the generators, it became possible to use the force of waterfall, river, or lake to turn the wheels of machines in distant cities. This was possible because electricity can be sent over copper wires from the power station where it is generated to the machines that use it. We see now that the great advantage of electrical power is that it is not expensive to send it to the places where it is to be used. Needing no pipes or pumps, it can be transported even more economically than oil.

Today Hydroelectric Power Stations are being built on the Larger Streams of the United States

Hydro comes from an old Greek word meaning "water." Hydroelectric power, therefore, means "water-electric" power, and the hydroelectric power stations are the places at which the power is made. When we speak of water power today we nearly always mean electrical power which has been produced by water wheels; hence the word which we shall use to describe it — "hydroelectric."

Since 1890 hydroelectric power stations have been built on most of our important rivers. Wherever great falls occur men are erecting water wheels and building electrical power stations. The largest single group of stations is at Niagara Falls, New York. These falls (shown in figure 92) are located on the boundary between the United States and Canada. In the past 35 years many great power stations have been built on both

FIG. 92. This is an airplane view of Niagara Falls. Goat Island divides the river at this point and makes two great falls. The one at the left is on the American side; that at the right is on the Canadian side. The four stacks shown in the left foreground mark one of the stations of the Niagara Falls Power Co. The other stations on both sides of the river are shown only indistinctly. (Courtesy of the Buffalo, Niagara, and Eastern Power Co.)

sides of the river. From the upper edge of Niagara Falls a tremendous 20-foot wall of water drops 144 feet. For years engineers stood before this great waste of power and wished for a way to prevent it by using the water to turn wheels. If only wheels could be made, they thought, which would withstand the force of the water and which could be controlled in great steel casings, enormous amounts of power could be generated. The engineers dreamed and planned and experimented, and, as a result of their efforts, today on each side of the river there are several large stations.

In each of these stations there are installed great steel pipes. The water is drawn from the river above the falls and allowed to drop through the pipes and to strike with enormous force on the water wheels at the bottom. This tremendous force, in turning the huge wheels, also turns the attached axles or shafts, revolving others which extend perpendicularly to the power station above. Since the upper end of the perpendicular shaft is connected

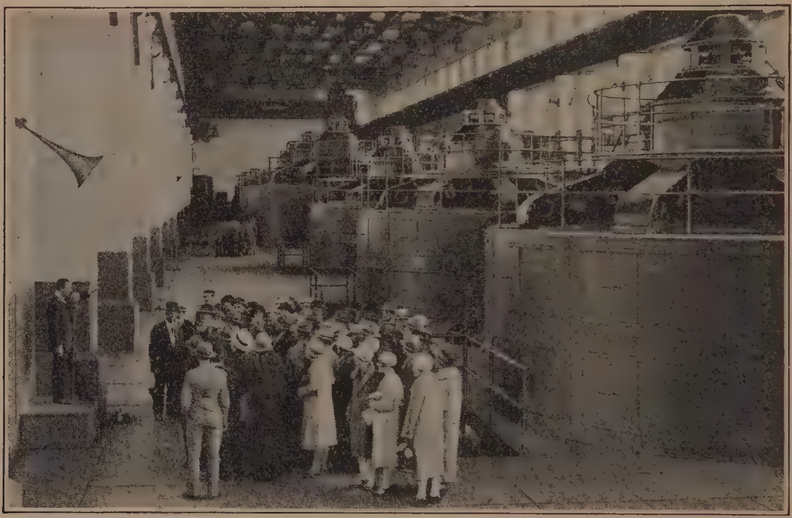

Fig. 93. The electric generators of one of the Niagara Falls stations. A number of visitors are being shown about. (Courtesy of the Buffalo, Niagara, and Eastern Power Co.)

with a generator, the turning of the water wheel causes the generator to turn also, and it is this turning of the generator which develops the electricity.

These Niagara stations are good examples of the hydroelectric power plants that are being built on most of our larger streams. In a recent year nearly 900,000 horse power was developed in the various stations around Niagara Falls. It is estimated that twelve times that amount could be developed with the complete use of the great falls.

On the entire earth there are few falls like those at Niagara. Lacking these, engineers make waterfalls by building high dams. Note how this has been done for the hydroelectric station at Long Lake, Washington, shown in figure 94.

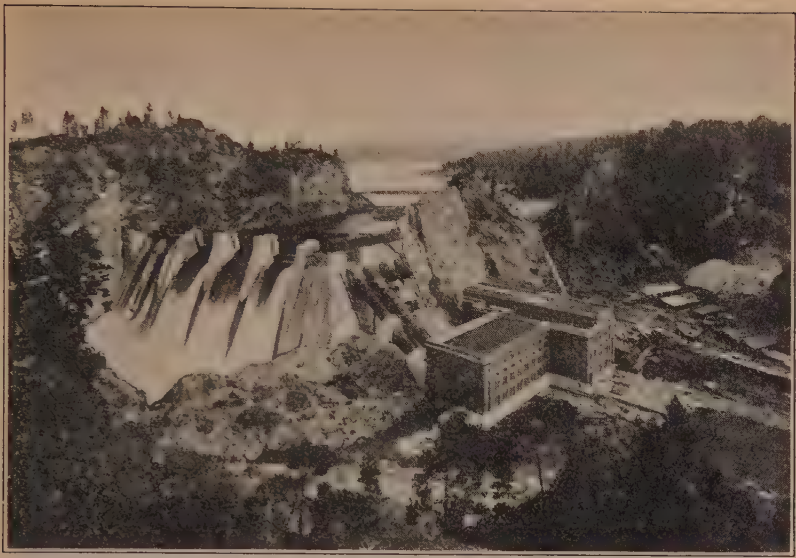

Fig. 94. The dam and hydroelectric power station at Long Lake, Washington. A waterfall has been made by erecting a high dam between two steep hillsides. At the bottom of the dam is a power station containing great water wheels. The water drops down through great pipes shown in the center of the picture. The falling water turns the water wheels and generates electricity which is sent to distant points. (Courtesy of the General Electric Company)

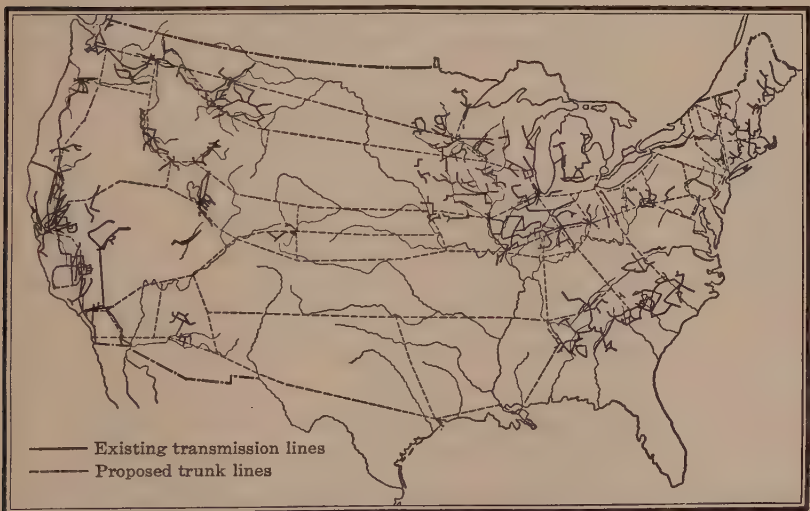

Fig. 95. The heavy black lines show where water power is now making electricity. The broken lines show how the engineers propose to connect these central stations by lines of wire through the regions where power is not available

Such dams are now being built at favorable points on almost all our larger rivers. The heavy lines in figure 95 show the many places where power stations have already been built. The chief ones are now located at the following places:

Name of Development	River	Horse Power
Niagara Falls (American side)	Niagara River	900,000
Muscle Shoals [1]	Tennessee	612,000
Conowingo Plant	Susquehanna (Pa.)	378,000
Pitt River	Pitt (Calif.)	500,000
Keokuk	Mississippi	160,000
Holtwood Plant	Susquehanna (Pa.)	158,000
Falls of the Ohio [1]	Ohio	135,000
Cross River Plant	Cross (Ala.)	109,000
Tallulah Falls Plant	Tallulah Falls (Ga.)	108,000
Caribou Plant	Feather River (Calif.)	90,000

Our Water Power Resources compared with our Resources of Coal and Oil

Water power has a great advantage over coal and oil. Once burned to make power both coal and oil are gone forever. Water, however, used to develop power at one point remains unchanged and as useful as ever at another point. After falling water has done its work in power stations, it is released and flows on with as much force as before. So with water power we have no serious problem of waste. Whereas coal and oil cannot be replaced, water power can.

In Chapter VII, figure 64, we learned that throughout the United States we are using a total of approximately 435,000,000 horse power. The upper left-hand graph and the right-hand graph in figure 96 show us that only a little more than one tenth of this is electrical power. The remainder is produced by the force of steam engines, gas engines, and other engines applied directly to machines, automobiles, etc.

The lower left-hand graph of figure 96 shows that already great amounts of hydroelectric power are being produced in the United States. It is impossible to secure exact figures; we must depend upon the estimates of experts; but we can feel certain that more than 12,000,000 horse power is already being generated in the

[1] Under construction.

great water-power plants of the country. This is nearly half as much electrical power as is produced from coal, more than all of that produced from petroleum, and much more than that produced from natural gas. Adding together the amounts of *electrical* power obtained from coal, water, petroleum, and natural gas, we have a total electrical-power development in the United

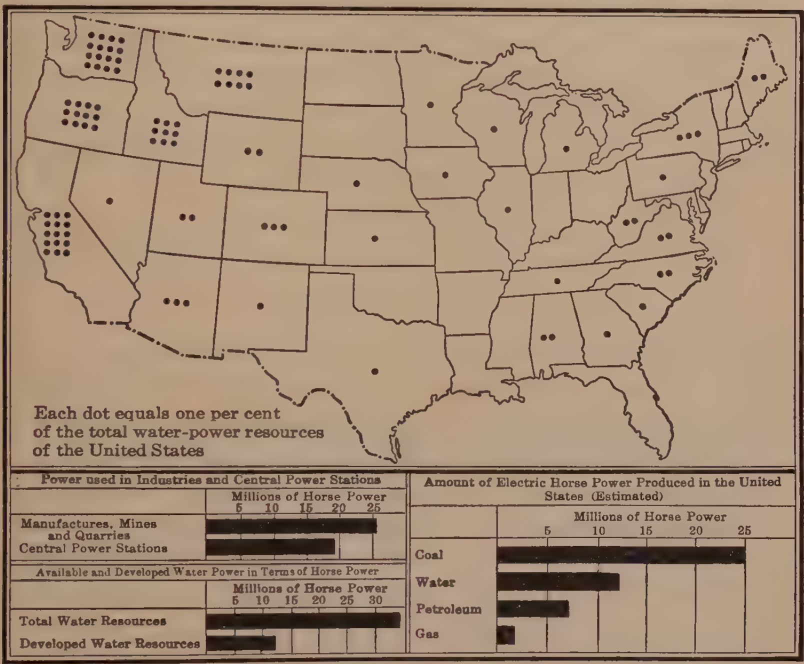

FIG. 96. The map shows to what extent water power can be developed in our various states. Note that the largest amount can be developed in the mountains of the Far West. The next larger amount is in the Appalachian Mountains of the East. Small amounts can be developed on the streams of the central plains. The graphs present important facts concerning the development of power in the United States

States today of about 43,000,000 horse power. Of this approximately one fourth is obtained from water. This is, indeed, a great increase since the opening of the first Niagara Falls plant in 1890.

We know that our stores of coal and oil are rapidly dwindling. Is there any hope that when they are gone we can get enough electrical power from the streams to take their place? Not if the engineers are right. Various estimates of the amount of electrical

power which we could obtain from all our streams have been made. The largest estimate (which supposes, to start with, that we could build power stations at every favorable point) is not more than 70,000,000 horse power. But this is only about one sixth of the actual power now used in the United States. Charles P. Steinmetz, who was one of America's greatest electrical engineers, studied the matter very carefully and said: "The hope that when coal begins to fail we may use the water power of the country as the source of energy is a dream, because if all the water power of the country were developed . . . it would not support our present demand . . . . Power developed from water may and should supplement that of coal, but can never replace it."

All Three Sources of Power are Needed — Coal, Oil, and Water

There is not enough water power available to meet our needs, and, as we have seen, coal and oil resources are being rapidly exhausted. What can we do to prevent this waste and to use all our resources more efficiently?

Engineers who have studied the problem have planned a gigantic power system which includes the use of all three of our power resources — coal, oil, and water. This superpower plan, as it is called, would convert much of our resources into electric power, and thereby bring about a saving. For example, when we studied the first attempts to turn the wheels of New England mills we learned how wasteful and how weak was power made directly by water wheels. But water wheels used to generate electricity produce great amounts of power with little waste. The saving comes in converting the direct power made by flowing streams into electric power, which can be sent great distances.

So it is with power generated in steam engines. This is wasteful of coal and oil. But steam power, also, can be used to turn the wheels of generators to make electricity, which can be sent over long distances.

Many people began to wonder if we could not use all our resources to generate electricity, the power that can be sent over

long distances and the most economical power we know today. This was the idea of the engineers. They therefore worked out a plan to supply the different sections of the United States with enough power for all their manufacturing needs.

According to this plan, where large amounts of water power are available central power stations are to be erected. But these will not depend on water alone. In these plants steam power produced by coal, oil, and gas will supplement the power of flowing streams in generating electricity. Lines of copper wires reaching out to all the cities, factory towns, and even the farms of the section will transmit, or send, this electric power to the machines it is to run or the homes it is to light and heat. As figure 95 shows, many of these stations and transmission lines are already at work. They are supplying efficient and economical electric power.

In most parts of the United States water power could be developed much more than it is today and the present transmission systems extended. If this were done, it is estimated that the saving on coal in factories and in mines and quarries would be about 100,000,000 tons a year, and the electrification of main lines of railroads would save 70,000,000 more tons a year.

The idea of combining our resources to supply electricity on a large scale is an idea of what is called *mass production* of power. In Chapter XII we shall see how manufacturing as we carry it on today makes use of mass production. To run the machines that do this manufacturing we need large-scale, or mass, production of power.

Power means progress in industrial America. With the perfection of the steam engine the march of modern progress began. With superpower we can continue it.

Great is the power in thundering rivers, in gushing oil, in black, hidden coal. But greater still is the combination of these sources of power in generating electrical energy, which can be sent over copper wires to factories, farms, and homes throughout the land.

INTERESTING READINGS FROM WHICH YOU CAN GET ADDITIONAL INFORMATION

Books

BOND, A. RUSSELL. Pick, Shovel, and Pluck. Scientific American Publishing Company, New York, 1920.

Chapter XII describes vividly how the Mississippi was set to work by means of dams and power houses.

JONES, FRANCIS ARTHUR. Thomas Alva Edison. Thomas Y. Crowell Company, New York, 1924.

An interesting account of the achievements of this eminent inventor.

*KAEMPFFERT, WALDEMAR B. (Editor). A Popular History of American Invention, Volume I. Charles Scribner's Sons, New York, 1924.

Part III, Chapter II (The Rise of Electricity); Chapter III (From Rushlight to Incandescent Lamp).

*KEIR, MALCOLM. The Epic of Industry (Volume V of The Pageant of America). Yale University Press, New Haven, 1926.

Chapter VII (The Era of Electricity).

LAMPREY, L. Days of the Leaders. Frederick A. Stokes Company, New York, 1925.

In Chapter XXV an account of how Edison made an electric light is presented.

*TAPPAN, EVA MARCH. Modern Triumphs (Volume XIV of The Children's Hour). Houghton Mifflin Company, Boston, 1916.

Pages 121–150 present dramatic stories of the building of the Mississippi Dam, the Arrowrock Dam, and the Niagara power houses. Pages 380–404 tell of "Edison and the Electric Light," a story of his long search the world over for a suitable filament for the electric lamp.

WILLIAMS, ARCHIBALD. The Romance of Modern Engineering. J. B. Lippincott Company, Philadelphia, 1921.

A well-illustrated account of "The Harnessing of Niagara" is included in this book.

Magazine Articles

"America's Greatest Water Wheel," *Scientific American*, February, 1928, pp. 122–124.

"The World's Most Powerful Machine," *Literary Digest*, June 26, 1926, pp. 20–21.

*"Uncle Sam, Spendthrift, X. We have 55,000,000 Potential Horse Power in our Rivers, of which we waste 44,000,000," *Scientific American*, June, 1927, pp. 398–400.

"We Lead the World in Water Power," *Literary Digest*, January 28, 1928, p. 23.

UNIT IV

THE INDUSTRIAL REVOLUTION

THE INDUSTRIAL REVOLUTION

BEFORE YOU STUDY CHAPTERS XI AND XII

In the story of machines and the power that runs them, there is another chapter of great importance — that which deals with **the material from which they are built.** *Before tremendous amounts of power could be developed and before the use of machinery could be extended to all kinds of work, men needed a strong material from which they could make powerful machines. Up to 1800 the material most frequently used was wood. The first water wheels, the first weaving looms, even the first railroad rails were of wood. But wood was not strong enough to be used in making powerful machinery. Furthermore, wood is so soft that it cannot be made into accurately fitting machine parts. So with the invention of engines and machines, men needed a strong and enduring material. They searched for it, experimented with various materials, and at last found a satisfactory one — steel, made from iron.*

Having completed our study of engines and mechanical power, we shall consider in Chapter XI the story of iron and steel; its great importance in the modern world; how men learned to free iron from its ore; how they discovered an easy way of changing iron into steel; how they learned to combine many other substances with iron to make fine grades of steel. We shall also learn something of the great iron resources of the world today and the importance of what are called "alloys" in the making of steel.

Do not forget that we are still studying the factors that have helped to produce the high standard of living in the United States. We have already considered the first two — namely, the location and the great area of the United States. We have also started the study of a third cause in our discussion of the three great power resources of our country. In studying iron in Chapter XI we are considering another of the great resources that help to give us our high standard of living.

In Chapter XII we shall study briefly the story of the Industrial Revolution (which began in the 1700's with the invention of engines and machines) and how it affected our whole industrial life. In that chapter, as in Chapters VI and VII, we shall find again many examples of the way in which scientific knowledge has brought about the new civilization in which we live.

CHAPTER XI

IRON AND STEEL: THE MATERIAL OF WHICH THE INDUSTRIAL WORLD IS BUILT

We live in the Age of Steel. Without great quantities of steel our modern civilization could not have been built. Without it we could not have our modern cities, our systems of transportation and communication, our great power plants. Our great skyscrapers are made of steel. There are thousands of miles of rails of steel; bridges are made of steel, and factory buildings are held up by steel. There are miles of machines filling the factories — all made of steel. Steel boilers and steel engines make the power to run these steel factories. Steel ships carry goods and people around the world. Steel everywhere. Steel in almost everything.

The story of steel, however, begins with the story of iron. Steel does not come directly from the earth. It is made from iron and other materials which are found in the earth. Iron has certain wonderful properties. If it is heated and then cooled suddenly it becomes very hard. When cooled slowly it becomes soft and pliable. It can be made as brittle as glass, or as bendable as copper. It can be made into one of the strongest of metals, but also into one of the weakest. It is most permanent when protected; when left exposed to the air it rusts away in a short time.

We commonly speak of iron and steel as if they were the same thing, but they are very different. The bridges, railroad rails, locomotives, and engines which make our industrial civilization possible could not exist if we used just iron. They do exist for two reasons: first, because men have used scientific knowledge to change iron into steel; second, because they have learned to produce steel in great quantities. Had these things not happened, we might have been living in much the same way that our forefathers lived in 1800. Not until about seventy-five years ago did men really become dependent upon steel.

How Iron was melted and prepared before Men learned how to do it Scientifically

Iron itself is found in the earth mixed with many other materials. Sometimes it is firmly embedded in rock. Sometimes it lies almost loose on the surface of the ground. It is nearly everywhere; but the chief problem has always been how to obtain it free from other substances.

The first step in freeing iron from the ore in which it is found was taken ages ago. How long ago this was we do not know. We are not even sure when man first discovered iron or when he first used it. Certainly the date must be many thousands of years ago. We know that ancient people had tools and implements made of it; for example, the Egyptians, the Assyrians, the Chinese, and the Greeks had them several thousands of years ago. The Romans, the Norse people, and other early Europeans knew how to make use of iron. Throughout all those thousands of years, however, iron was only used in small quantities. People knew that by the use of charcoal and sufficient heat the iron in the rock could be melted out, and that the metal so obtained could be hammered into useful shapes. They had not learned, however, how to free it *easily* from its ore. Their methods were very crude and only small amounts of the metal could be obtained. (See figure 97.)

Fig. 97. A primitive method of preparing iron, used in India. Notice the man blowing through a bamboo to keep a draft of air under the fire. Contrast this with the modern blast furnace illustrated in figure 100. Could much iron be made in a day by such primitive methods? (Courtesy of Ford Motor Company)

After a time men learned to build crude stone furnaces with chimneys (called forges) so that they got a better draught to fan the flames than they could get by blowing through a tube. In these old charcoal-burning forges the intense heat melted the

ore more rapidly. The iron dropped to the bottom of the furnace and was removed. But this iron still contained particles of rock and other impurities, so again it was melted, this time with layers of charcoal which increased the heat. More impurities were removed, and thus the iron became of better quality. It was then cooled, hammered, reheated, and hammered over and over again. As a result a small quantity of hard, strong metal was obtained. Hundreds of years ago, the Spaniards learned how to do this so well that a metal resulted as fine as our modern steel. As you can imagine, however, this fine metal could be produced only in very small quantities. So precious was it that it was used only for absolute necessities like weapons. The art was kept secret and for generations was passed down only to the children and favored apprentices of the skilled workmen.

FIG. 98. This picture illustrates the primitive ways formerly employed in removing impurities from iron. It was done by heating and hammering over and over again. (Courtesy of Ford Motor Company)

Throughout all this time iron was so difficult and expensive to make that it was a real luxury. In the early days of this country the colonists got their iron nails from England and every nail was a luxury. Even when iron nails were first made here they had to be slowly hammered out by hand. Horseshoes, tires for wagon wheels, chains, and tools were laboriously made by blacksmiths. The forges in which they were made were little better than those which had been used for hundreds of years. It is estimated that in Europe even as late as 1700 the yearly use of iron was only two pounds per person. Today the production of iron and steel is 700 to 800 pounds per person. This does not mean that each person actually buys 700 or 800 pounds of iron and steel. It means that for each person in our population 700 to 800 pounds of iron and steel have been produced and made into rails, engines, etc.

The Kelly-Bessemer Process

One day in 1846 William Kelly was sitting in front of his Kentucky iron-refining furnace. It was as crude as all the other refining furnaces of the time. In fact it was little better than the very early ones just described. In it "pig iron" (that is, iron which has been melted out of the ore but is still full of impurities) was refined by the laborious heating and hammering method.

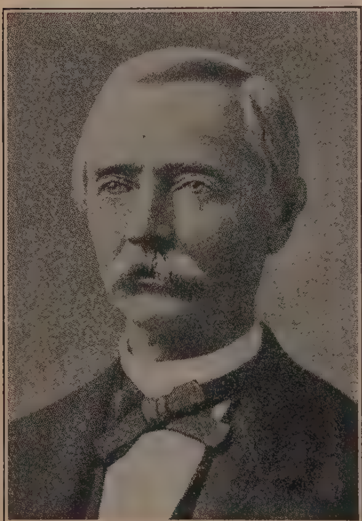

Fig. 99. William Kelly, a Kentucky kettle-maker, who in 1846 discovered the "air process" of refining iron[1]

The molten metal in the furnace glowed and shone, bright and yellow as fire. But suddenly William Kelly noticed a strange thing. Over at one edge of the mass, where there was no charcoal and where cooling air played over the mass, there darted a gaseous flame, intensely hot and blinding white. Was it not strange that the hottest spot of all should be at the edge of the metal, where there was no charcoal and where nothing but a cold draft of air touched the hot metal?

Right then there dawned on William Kelly the discovery which helped to make possible our great railroads, our tall buildings, our tremendous factories, our whole new civilization. He saw it all in a flash. He leapt to his feet with a shout. He tried out his idea and it worked. He ran out to tell his friends. His delight was so unrestrained that the neighbors thought him crazy. Only two or three listened to him — two English ironworkers and the village doctor. This is the way Kelly explained his idea to them:

"In our furnaces we now put layers of charcoal, which get hot enough to burn the impurities out of the ore. You know how slow and unsatisfactory this way is. But the carbon in the heated metal

[1] From *The Romance of Steel*, by Herbert N. Casson. Used by permission of Laidlaw Brothers, Inc., owners of the copyright.

can be removed in a much simpler way. It can be done by blowing air through it! Many of the impurities can be burned out by a blast of air in a few minutes, instead of being slowly and laboriously melted out in the way we have been doing."

For ages men had tried to keep cold air away from the hot iron, lest they cool it suddenly. They did not know that air blown through the molten mass would really make the heat greater. Kelly discovered this. He did not try to keep his discovery secret,

FIG. 100. The picture on the left shows the remains of a blast furnace built about 1800. Near it a new modern furnace has been erected. This is shown in the picture on the right. These, therefore, represent the oldest and newest types of blast furnace in America. (Courtesy of the Weirton Steel Company, Weirton, West Virginia)

as the sword-makers of the Middle Ages had kept their processes secret. He called in the ironworkers of his neighborhood and gave a public demonstration.

So these ironworkers from western Kentucky came and stood about Kelly's furnace, making fun of him and saying that he had "gone a little crazy." But Kelly paid no attention. He blew air through some melted pig iron. To everyone's amazement the metal grew white-hot. A blacksmith seized the iron, cooled it, and in twenty minutes produced from it a fine horseshoe. He flung it at the feet of the ironworkers, and seizing a second scrap of the metal, made nails and shod a horse that stood near. Pig iron,

which had little value because of its impurities, had been so changed that it could be made into horseshoes and nails in *twenty minutes*!

The Steel Age was near at hand, but the ironworkers of Kentucky did not realize it. It was too easy. "Some crank'll be burnin' ice next," said one. They shook their heads and went

Fig. 101. How the modern blast furnace works. Height, 90 feet; diameter, about 25 feet; makes 550 tons of iron every 24 hours. Note the alternate layers of iron ore, coke, and limestone. At the top of the furnace the heat is about 400°; at the bottom 3500°. Notice that the useless slag has dropped to the lower part of the furnace. The iron ore and slag are drawn off separately. (Courtesy of the *Scientific American*)

home unconvinced, but in after years they boasted that they had seen the first public production in the whole world of "Kelly," or "Bessemer," steel.[1]

Seven years later Sir Henry Bessemer, in England, made this same discovery. The process is now called by his name, but it is the same process that Kelly first demonstrated to his Kentucky neighbors.

[1] Adapted from *The Romance of Steel*, by Herbert N. Casson, pp. 5–7. Used by permission of Laidlaw Brothers, Inc., owners of the copyright.

Today in great Bessemer "converters" the impurities are blown out of molten pig iron in from ten to twenty minutes. William Kelly's discovery did away forever with the old charcoal and hammering process, which had required hours and even days.

How Iron Ore becomes Steel by Modern Methods

As it comes from the ground most of our iron ore is only half iron; the rest is impurities. These are the principal steps in the treatment of iron today, from the time the iron ore is delivered to the steel mill until it is rolled into the desired steel forms:

The first step. The ore, which is brought from the iron mine, is put into the blast furnace with coke and limestone in appropriate amounts. A blast furnace is a huge steel tube lined with brick. (Note the layers of coke, limestone, and ore in the furnace at the left of figure 101.) Hot air, which is forced into the blast furnace at the bottom, keeps the fire going. The heat changes the limestone to lime and carbon dioxide, and the lime combines with impurities to form slag. The heat, which is terrific, separates the iron from the ore and the melted iron drops to the bottom of the furnace. From time to time the iron and the slag are drawn off separately. The iron is poured into molds and cooled. It is then called pig iron. The pig iron still contains 8 per cent of impurities, of which about half is carbon.

FIG. 102. This shows hot melted steel being poured from a giant ladle into ingot molds. (Courtesy of the United States Steel Corporation)

The second step. The pig iron is further refined by being remelted and having blasts of air blown through it. The air unites with the remaining carbon and other impurities, removing them.

The third step. But finished steel needs some carbon to produce strength and hardness. The right amount is now added to the

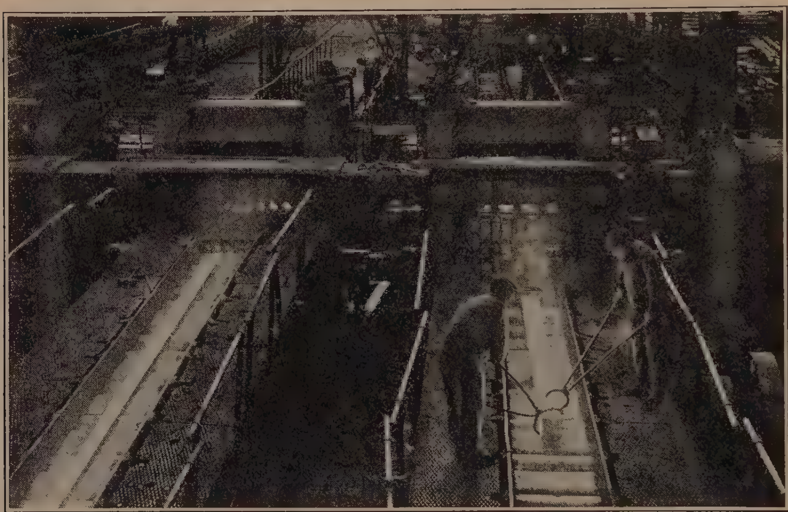

Fig. 103. This picture shows how a railroad rail is shaped. The steel is heated until it is white-hot; this is rolled back and forth through the heavy mills until it is pressed into the desired shape. In this way many steel parts are made. (Courtesy of the Bethlehem Steel Company)

remelted metal. Manganese, silicon, and other substances are also added. The metal is poured out into the molds, where it cools again and hardens into *ingots*. These steel ingots are then reheated and rolled into the desired forms and sizes for rails, rods, girders, wheels, automobile rims, wires, etc. (See figure 103.)

After 1850 the Production of Steel increased rapidly

It is now more than 80 years since Kelly invented the air process of making steel out of iron. In that time the manufacturing of steel has become one of the greatest industries of our country.

The graph of figure 104 tells the astonishing story of the production of pig iron, which, as you have just read, is the first step

in the making of steel. In 1800 we produced such a small amount of iron that it is impossible to represent on the same graph both the amount for that year and the amount for 1926. In the latter year 43,000,000 tons of pig iron were produced!

But how recently has steel been made in large quantities! In 1860 we produced about 1,000,000 tons of pig iron from which steel could be made. In the next ten years the amount doubled in quantity. In this period the war between the states of the North and of the South was fought (1861–1865), and the demands for iron and steel increased rapidly. The armies of the North needed guns by the tens of thousands, and also shells in thousand-ton lots. Troops had to be moved about rapidly, and hence railroads were hastily laid down. There was a constantly growing demand for steel rails and for steel locomotives.

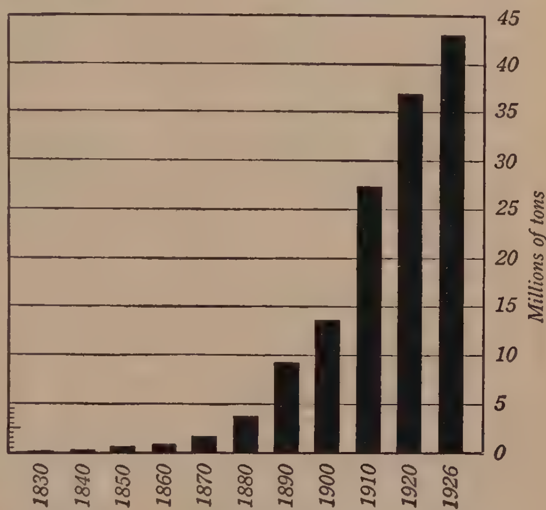

FIG. 104. The number of tons of pig iron produced in the United States from 1830 to 1926. Notice how slowly it increased until about 1870 and with what rapidity it increased after that time

No sooner was the war over than the United States entered upon a remarkable age of industrial expansion. Factories were built in many parts of the country. Machines made of iron and steel were taking the place of hand labor. Cities, with their great buildings and their modern systems of transportation and communication, were growing. Transcontinental railroads were being built. All these things required great quantities of iron and steel. This is shown clearly in the bar graph of figure 104.

Vast Iron Resources were discovered in the United States

Fortunately, a few years before the iron and steel manufacturers began to need great quantities of ore the most remarkable deposits in the world had been found in the United States. These deposits lay in Minnesota (see figure 105), in a region that was then a complete wilderness, without roads or inhabitants except a few scattered tribes of Indians.

The discoverer of iron wealth in this wild and distant region was a Michigan man named Philo M. Everett. In 1845 Everett, with four other white men and two Indians, undertook the dangerous trip through Lake Michigan and Lake Superior to the region which is now the eastern part of Minnesota. One day as they were traveling inland by trail from Lake Superior, the Indians suddenly halted and pointed ahead to a hill. "Iron mountain!" they exclaimed. "Indian not go near. White man go." Eagerly the white men went where the Indians were afraid to go and found a great hill that looked like solid iron ore. What a prize for the smelters of iron! Rich ore right near the surface of the ground. (See figure 106.)

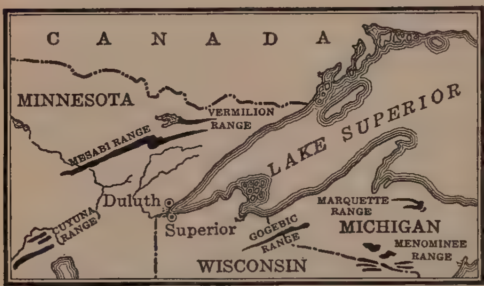

Fig. 105. This map shows the rich iron deposits near Lake Superior. (Courtesy of the *Scientific American*, February, 1924)

Iron ore is usually found deep in the earth, as coal is (see figure 107), and must be mined in much the same expensive way. Imagine what a treasure this Mesabi iron seemed to the discoverers — ore that could be shoveled like dirt almost off the top of the soil!

When Everett and his men showed the people at home the rich samples of ore that they carried back with them, others began to go into the region in search of iron. It was not long before mines were opened and towns and cities sprang up. Several great ranges of ore were found in that region. These are shown by the black spots on the map of figure 105.

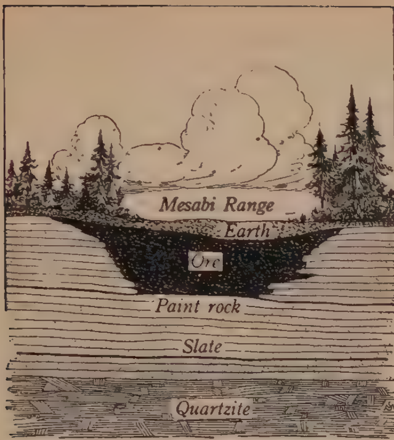

FIG. 106. A cross section showing that the iron ore in the Mesabi Range lies near the surface of the ground. Compare this with the neighboring Vermilion Range (figure 107), in which the iron ore lies buried deep in the earth. (Courtesy of the American Iron and Steel Co.)

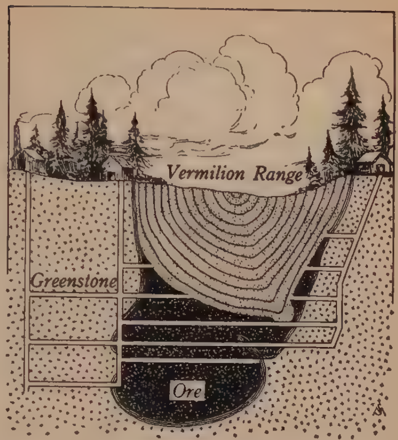

FIG. 107. This figure shows that in the Vermilion Range the iron ore lies deep in the earth and is much more difficult to mine than that in the Mesabi Range, as you will see when you look at figure 106. (Courtesy of the American Iron and Steel Co.)

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FIG. 108. This picture shows how iron ore which lies close to the surface is mined. How different it is from the mining of coal!

The Mesabi Range yields annually 60 per cent of all the iron mined in the United States and 25 per cent of all the iron that is mined in the world. A Mesabi iron mine is indeed one of the world's wonders. As figure 108 shows, these mines are open to the broad daylight. Furthermore, the ore is so loose that it can be scooped off with a great steam shovel. There is no blasting, no laborious lugging of chunks of ore, as in the case of coal-mining. A few workmen operating one steam shovel "can load more ore in one hour than 500 delving miners can bring up in a day from the average rock mine. At every swing of the steam shovel's powerful arm five tons of ore drop into a big steel car. The arm swings twice a minute." [1]

The Location of the Iron Mines and of the Steel-Manufacturing Mills

These iron ranges are located far north near Lake Superior, but most of the mills in which iron ore is refined into steel are hundreds of miles away in Pennsylvania, Ohio, Indiana, and Illinois. The ore is shipped from the mines by railroad cars to Duluth and Superior, on Lake Superior. There it is loaded by machinery onto lake ore boats and shipped cheaply to the manufacturing cities near Chicago, Detroit, and Pittsburgh. The map of figure 109 shows that most of the iron ore is transported through the Great Lakes to the Pennsylvania and Ohio iron-manufacturing districts.

The second largest amount is shipped to the steel manufacturing district that has grown up around Chicago and Milwaukee on the southern shore of Lake Michigan. A new steel-manufacturing center is near Birmingham, Alabama. Fortunately for the people of that region both coal and iron ore are found there fairly close together.

Why are most of the steel works in Pennsylvania, Ohio, Illinois, and Indiana instead of in Minnesota near the iron mines? There are several reasons. The first and perhaps the most important is that large amounts of coal are mined in these steel-manufacturing districts. (Compare the coal map of figure 70, Chapter VIII,

[1] From *The Romance of Steel*, by Herbert N. Casson, p. 56. Used by permission of Laidlaw Brothers, Inc., owners of the copyright.

with the map of steel-manufacturing centers, figure 109.) To smelt one ton of iron ore requires between two and three tons of coal. It is cheaper, therefore, to ship the iron ore to the coal districts than to ship the coal to the iron mines. There are other reasons. The Pennsylvania-Ohio and Lima-Indiana coal districts lie in our great industrial manufacturing section. In that section are most of our great cities. More people live there than in any

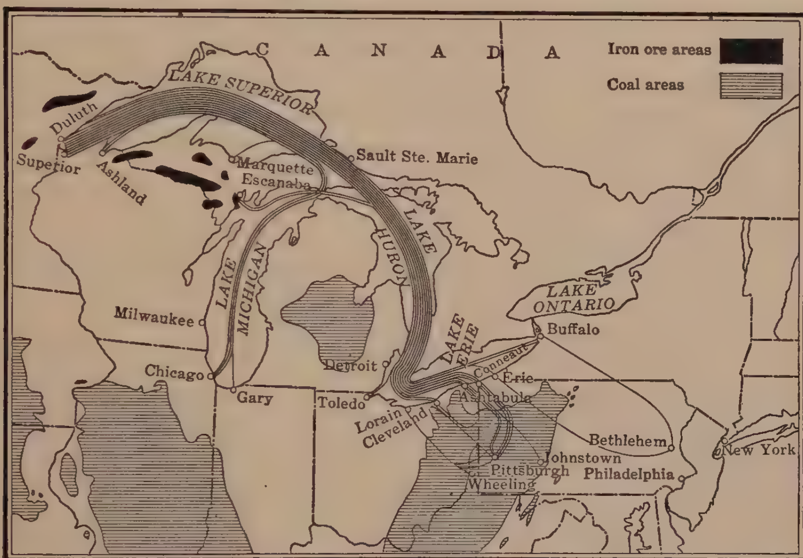

FIG. 109. The lines through the Great Lakes show the routes by which ore is shipped to the steel mills of Pennsylvania, Ohio, Indiana, and Illinois. On the return trip the boats carry coal to the people of the Northwest

other section of the country; hence more steel is used there. Because the coal is there and the "market" for steel is there it is cheaper to make the steel in this section than near the iron mines in Minnesota.

WHAT SHARE OF THE WORLD'S SUPPLY OF IRON IS MINED AND HOW MUCH STEEL IS PRODUCED IN THE UNITED STATES?

Iron is found in rocks and soil all over the world. In fact, more than 4 per cent of the surface of the earth is iron. The map of figure 110 shows that it is located in all the six continents. Europe

has a great supply of it; Asia, Africa, and Australia have it; small deposits are found in South America. But it is only in the United States and in the three great industrial countries of Europe — Germany, France, and Great Britain — that *large amounts of iron are mined and made into steel.* Of the four leading industrial countries, therefore, the United States has within its borders the largest supply of iron ore. Furthermore, it is producing much more pig iron than are the other three. The second bar graph of figure 110 shows that in 1925 we produced more than three times as much pig iron as did Germany, four times as much as France, and six times as much as Great Britain. No comparison is made with Japan, Belgium, Russia, and other countries, which produce only a small amount of iron.

Does the United States lack Other Things needed to make Modern Steel?

It is clear, therefore, that our country has tremendous supplies of iron ore. They are so great that there is little prospect that they will be exhausted in many hundreds of years. To make the different kinds of steel upon which our new civilization depends, however, other minerals are needed to mix with the iron. Let us see whether the United States has a sufficient supply of these indispensable materials.

Steel, as we know it today, is an *alloy*; that is, it is a mixture of several metals. As it was first known steel was merely hammered iron. You have learned that the iron was melted in a forge, then melted and hammered again and again until all the impurities were beaten out of it. This process was very slow, and only a small amount of steel could be obtained by it. Then as our scientific knowledge of chemistry increased, men learned how to mix iron ore, chromium, tin, nickel, and other ores to produce different kinds and grades of steel. This they did by melting them so that they would mix thoroughly. These different varieties of steel are called steel alloys; that is, they are not pure iron obtained just by heating and hammering.

Nearly every metal thing that we use today is an alloy. Copper utensils, for example, are not pure copper; they are copper mixed

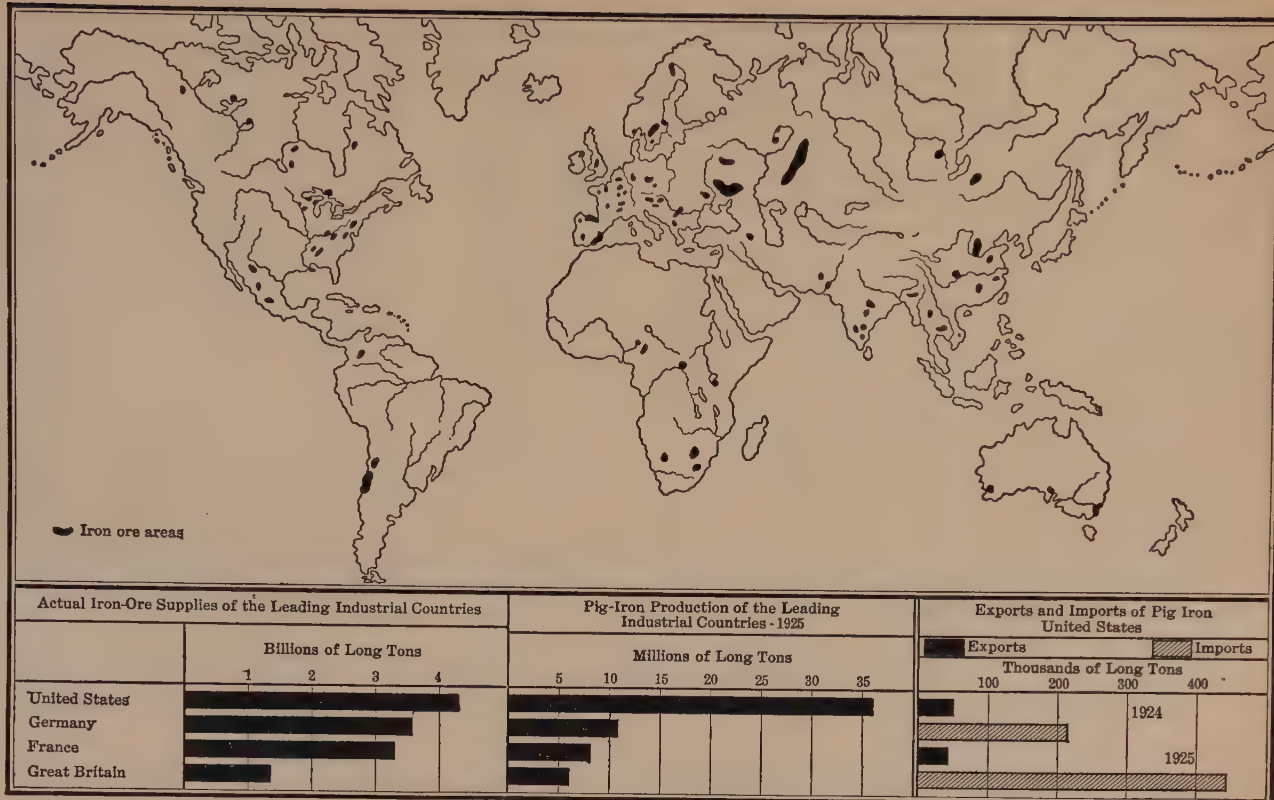

FIG. 110. Important facts concerning the iron resources of the earth and the production of pig iron

with other elements, such as tin. Likewise such steel products as railroad rails are not simply iron and carbon; the steel from which they have been made contains manganese. Other important elements enter into the manufacture of almost everything made of steel. Each one of them does something to make the steel different. Some of them harden it; others make it less brittle. Still others make it able to withstand heat or cold.

We have spoken of the importance of mixing manganese with iron in making steel rails. Likewise, chromium must be mixed with

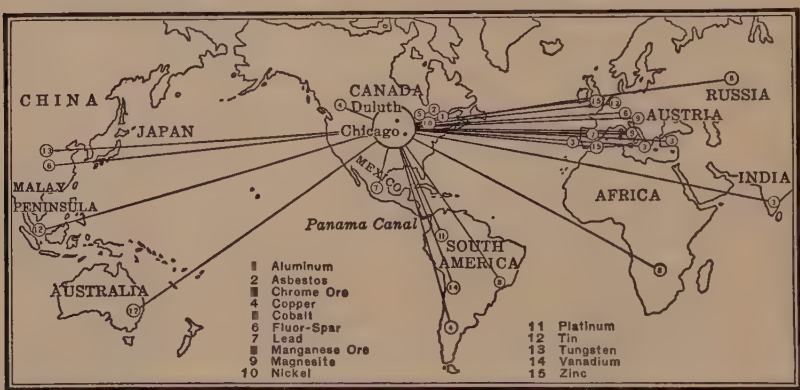

FIG. 111. The circles on this map show where the ores are obtained that are needed in the making of different kinds of steel in the United States. Notice that we draw them from all parts of the earth. The numbers in the circles refer to the key list of ores printed on the map

iron to make the steel for the great machines that do so much of our work. Rock-crushers, steam shovels, lifting cranes, stamping machines, smashing machines — all these must be made of very strong material. In making parts for these machines we must also have cutting tools of the very hardest steel. To make such machines the American steel mills absolutely depend upon having a supply of chromium. Do we have enough within the United States to supply all our own needs? Although chromium is found in several countries we have very little within our own borders. The United States Geological Survey estimated a few years ago that our entire supply would not last twelve years. Nevertheless, we use more than any other nation in the world.

What about nickel? We need nickel also in the manufacture of steel. Nickel, which every small child learns to recognize, is used in making nickel steel, which is necessary for armor plate, for railroad rails, for bridges, for the heavy parts of electrical machines. Yet we depend on other countries for our nickel.

So it is with other materials — tungsten, vanadium, etc. — which must be mixed with iron to produce special grades of steel without which our industrial civilization cannot exist as it is to-day. We must buy these ores from other countries. We do not have them in sufficient quantities within our own borders.

Recently the president of one of our great steel companies stated that in order to produce steel goods — rails, beams, etc. — he purchased supplies of 40 different materials from 57 countries other than the United States. These materials included (1) ores like manganese, nickel, tin, tungsten, aluminum, antimony, vanadium, chromium, and copper; (2) other things like crude mineral oil, linseed oil, palm oil, nitrate of soda, jute, etc. Some of these of course were needed in our steel mills only in very small quantities, but several were so important that our steel industry could not exist without a large and steady supply of them.

This completes our outline of the story of steel. It is so very important to our modern understanding of civilization that we suggest that you prepare a careful summary of the points which have been made.

INTERESTING READINGS FROM WHICH YOU CAN GET ADDITIONAL INFORMATION

Books

*Bachman, Frank P. Great Inventors and their Inventions. American Book Company, New York, 1918.

See Chapter IX (Henry Bessemer and the Making of Steel).

Bishop, A. L., and Keller, A. G. Industry and Trade. Ginn and Company, Boston, 1923.

Chapter XIV is a good description of methods of working an iron mine.

*Bond, A. Russell. Pick, Shovel, and Pluck. Scientific American Publishing Company, New York, 1920.

Chapter XIII (Taming Steel with Fire) presents a striking description of work in a steel mill.

*Bridges, T. C. The Young Folk's Book of Invention. Little, Brown & Company, Boston, 1926.

Chapter IV (Iron, Tin, and Steel) gives an interesting account of the mining and manufacturing of each of these basic metals.

Forman, S. E. Stories of Useful Inventions. The Century Co., New York, 1914.

The history of the forge is included in this book.

Fraser, Chelsea C. Secrets of the Earth. Thomas Y. Crowell Company, New York, 1921.

A very good book, describing the mining of iron ore and other important minerals.

*Kaempffert, Waldemar B. (Editor). A Popular History of American Invention, Vol. II. Charles Scribner's Sons, New York, 1924.

Part IV, Chapter I (The Story of Iron and Steel), Chapter II (Mining Copper and the Nobler Metals), and Chapter V (The Story of the American Lumbering Industry) are especially valuable.

*Keir, Malcolm. The Epic of Industry (Volume V of The Pageant of America). Yale University Press, New Haven, 1926.

Chapter IX (Twin Giants).

Marshall, Leon C. The Story of Human Progress. The Macmillan Company, New York, 1925.

Pages 85–102 (Man's Conquest of the Metals).

Rocheleau, W. F. Great American Industries, First Book (Minerals). A. Flanagan Company, Chicago, 1927.

Pages 75–112 describe iron mining and steel-making.

Smith, J. Russell. The Story of Iron and Steel. D. Appleton & Company, New York, 1920.

A full account of the steps from ore to finished steel.

Tappan, Eva March. Diggers in the Earth. Houghton Mifflin Company, Boston, 1916.

Pages 57–64 give a story of iron mining; easy to read.

*Walker, C. R. Steel: The Diary of a Furnace-Worker. The Atlantic Monthly Press, Boston, 1922.

One of the best books describing the life of a steelworker in 1919.

Williams, Archibald. The Romance of Modern Mining. J. B. Lippincott Company, Philadelphia, 1927.

Chapter XX describes clearly the ways in which an iron ore deposit is mined.

Magazine Articles

*"Industry's Greatest Asset — Steel," *National Geographic Magazine*, August, 1917, pp. 121–156.

"Machining Mountainous Masses of Metal," *Scientific American*, January, 1926, pp. 22–23.

CHAPTER XII

THE INDUSTRIAL REVOLUTION: FROM HAND TOOL TO MACHINE

You have learned that the United States is a leading industrial country. You learned three of the four principal factors which account for this. You have studied the effect of its fine location in a stimulating and productive climate. You have seen the ways in which its size, its people, its great power resources, and its stores of iron have helped to make possible our new civilization.

FIG. 112. A simple tool. With his hand screwdriver, the man will tighten one screw at a time. Compare this simple tool with the complicated machine in Fig. 113. The simple tool and the great machine are made to do the same thing—tighten screws; but when thousands of screws have to be tightened daily, the tool is inefficient

FIG. 113. A complicated machine. This machine is a giant, power-driven screwdriver. It tightens sixteen screws at a time. The man does not tighten the screws himself. He simply controls the machine. This is an illustration of the way in which machines have made large-scale production possible. (Courtesy of Ford Motor Company)

You will now study another cause for our high standard of living: the use of *scientific knowledge in the invention and perfection of machines.* You have already learned how scientific knowledge enabled us to produce mechanical power, to use our coal, oil, and water more efficiently, and to make undreamed-of quantities of steel. Now you will see how it changed ways of manufacturing.

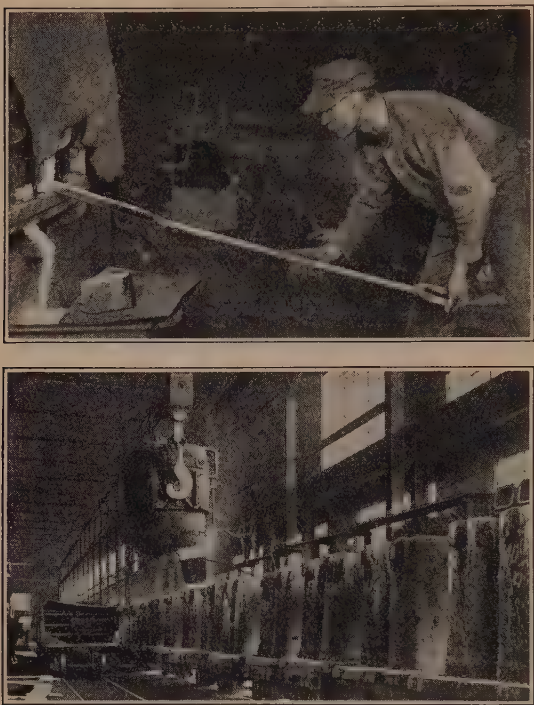

FIG. 114. The old hand method and the new mechanical way of pouring hot iron. In the picture at the top the workman is letting a little stream of hot iron run into a small mold. In the picture below it a large ladle moved by great overhead cranes empties hot iron into massive molds. (Courtesy of the Keystone View Co. (top) and of Bethlehem Steel Co. (bottom))

Certainly nothing has been more astonishing than the way in which the American people have turned from handwork to machine manufacturing. Only 150 years ago there was hardly a machine on the North American continent. As late as the close of the Civil War, in 1865, much of the work in the United States was still done by hand. Today there are millions of machines. In 1923 these facts were true:

The number of factories was about	196,000
The number of persons engaged in machine manufacturing (1920) was about	12,800,000
These factories used raw materials worth about	$34,700,000,000
They made goods worth about	$60,600,000,000
The workers received in wages about	$11,000,000,000

All because of machines which are driven by mechanical power generated from our great power resources.

Through scientific knowledge we have discovered mechanical power, learned the secret of electricity, produced steel, and made machines. Machines plow, cultivate, and harvest our farms. Machines spin our yarn, weave our cloth, and make our garments. Machines grind our corn and wheat, make our flour and bread, prepare our cereals, and can our vegetables. Machines transport us at high speed from place to place. Machines enable us to speak to each other almost instantaneously over long distances. Machines entertain us in the theater, in the "movies," and over the radio. Truly, we live in the Age of Machines.

Yet this Age of Machines is but a tiny part of man's long history; indeed, as the time line of figure 43 shows, it is only about 200 years. For thousands of years men did their work without machines. Only slowly, indeed, did they learn how to use even simple tools; then rapidly, after 1750, they learned how to make complicated machines. The change from doing work slowly and laboriously with hand tools to doing work efficiently and swiftly with machines really came, therefore, very suddenly. So we speak of it as the *Industrial Revolution.* Let us see how it came about.

Man's Slow Advance in the Improvement of his Tools

How do we learn today about the civilizations of people who lived before the days of writing or of historical records? From the tools they left behind them. In Asia and Europe, — indeed, all over the earth, — our scientists and historians today find the tools left by earlier peoples. By examining these tools they are able to sketch fairly accurate pictures of life thousands of years before written history begins. From the tools people used we can learn something about the way they lived. Their tools tell us much about their homes, how they cultivated the soil, and how they made and used things.

In advanced civilization we always find efficient tools and machines. Primitive people, however, had only a few simple tools. One historian described in the following way the invention of the very first tools: "The greatest benefactor of the human race died more than half a million years ago. He was a hairy creature with a low brow and sunken eyes, a heavy jaw, and strong, tigerlike

teeth. He would not have looked well in a gathering of modern scientists, but they would have honored him as their master. For he had used a stone to break a nut and a stick to pick up a heavy boulder. He was the inventor of the hammer and the lever, our first tools, and he did more than any human being who came after him to give man his enormous advantage over the other animals with whom he shares this planet.

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FIG. 115. The old and the new ways of digging. How many of these men working with picks and shovels do you suppose it would take to do as much as the one steam shovel you see here? How long do you suppose it would have taken to dig the Panama Canal, using picks and shovels?

"Ever since, man has tried to make his life easier by the use of a greater number of tools."[1]

The tools that the earliest people left behind them were made of flint. Later peoples left better tools of horn and bone. These three things — flint, horn, and bone — were the only materials for tools that men knew during thousands of years. Copper, iron, tin, etc., so widely used today, were not employed until a few thousand years ago, shortly before the first records of written history.

Figure 116 illustrates how man has learned to improve one simple tool, the hammer. Each object shown in the figure represents a hammer used by man at some stage of his development. What a difference between the crude, handleless stones and the well-finished iron hammers with handles. A long time passed before men learned to increase the force of their hammering by

[1] Hendrik W. Van Loon, *The Story of Mankind*, p. 402. Boni & Liveright, New York, 1921.

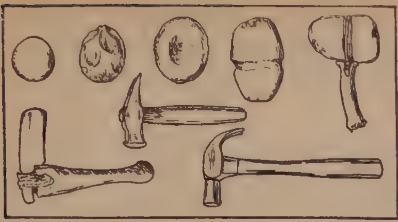

FIG. 116. This is how the scientist believes man learned to make the hand hammer he uses today. Compare the hand hammer with the machine hammer shown in figure 66

attaching a handle to the stone. When they learned to do this they made one of their greatest advances in the improvement of the hammer.

Ever since early man discovered how to make the first hammer and the first lever, people have tried to make life easier by inventing other tools. As thousands of years passed they were able to invent cutting and boring tools — the knife, the saw, the ax, and the gimlet. Slowly they invented crude farming tools. They made the plow by sharpening sticks. They hollowed out stones to use in grinding grain.

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FIG. 117. For hundreds of years men were trying to make machines of one sort or other. They were not very successful. This is an artist's drawing, illustrating the use of crude stone-throwing devices in the wars of the Crusades, during the twelfth century

At the same time they invented and improved tools for providing clothing, shelter, and transportation.

In the matter of providing clothing we know that even several thousand years ago the Chinese, the Egyptians, and other ancient peoples had tools and very simple hand machines with which to spin yarn and weave cloth. As newer civilizations grew up the people took over the ideas of the older ones. Very little improvement, however, was made in these crude tools and ma-

chines until 200 years ago. In Europe, as recently as the early 1700's, people spun yarn on the hand spinning wheel and wove cloth on the hand loom.

The Coming of the Industrial Revolution

What is this Industrial Revolution that we hear so much about? It began in the 1700's with the invention of the steam engine and of the first complicated cloth-making machines. It is really nothing more or less than the story of the invention and use of engines and machines. These have completely made over man's ways of living. The changes have been so great and so rapid that people speak of them as a revolution.

You have already studied how powerful engines were invented — how Watt made the first satisfactory steam engine, and how others improved it. You have seen how inventors applied the power of steam in a new kind of engine, the steam turbine. You have read how men learned to burn oil, to make the power in gas engines, to use water to run electric generators, and likewise to use coal and oil to generate electric power. The invention of these engines forms a part of the Industrial Revolution.

But engines would amount to little if we lacked ways of using the power they make. So the story of the Industrial Revolution is not only the story of engines. It is also the story of the invention of many other machines: machines, for example, for the weaving of cloth, for the making of shoes, for the raising and preparing of food, and for the making of automobiles.

The complete story of the Industrial Revolution would fill many volumes. It would tell of the invention of an almost countless number of machines. In the short space of this book it is impossible to discuss many of these. In the present chapter only three examples can be studied: *First*, the revolutionizing of the making of yarn and cloth by the invention of spinning and weaving machines. *Second*, the transformation of the shoe industry through the invention and use of shoemaking machines. *Third*, the revolution in land transportation by the invention of machines which helped to produce cheap and practicable automobiles. The first two examples deal with the production of

clothing; the third deals with rapid means of transportation. In Chapter XXIII we shall study the way in which machines have revolutionized farming.

The first example: hand spinning and weaving changed to machine manufacturing after 1750

The great change came about first in England in the cloth-making, or textile, industry. For hundreds of years yarn had been spun by hand on crude spinning machines (see figure 118) and woven into cloth by hand on simple looms. The work was exceedingly slow, and not more than a few yards of cloth could be woven in a day. After the year 1750, English workers invented new machines which made it possible to spin and weave rapidly and easily.

FIG. 118. Before the days of spinning machines yarn was spun by hand, a single thread at a time. This illustrates how the work was done on an old spinning wheel. (Photograph from the Keystone View Co.)

In 1764 a spinner by the name of James Hargreaves invented a spinning machine. It worked on the same principle as that of the old-fashioned spinning wheel. It enabled one person, however, to spin from eight to eleven threads instead of only one thread as on a spinning wheel. (See figure 119.)

A story is told of the way in which Hargreaves's machine came to be invented and called a "jenny." It is said that in coming hastily into the house one day he knocked over his wife's spinning wheel. He noticed that it continued to revolve horizontally instead of vertically. It is believed that from this accident Hargreaves saw the possibility of making a machine that would turn several spindles at once. He named the machine after his wife, Jenny, and these spinning machines were spoken of as "jennies."

One invention led to another. In 1768 Arkwright invented a way of running spinning jennies by water power. His machines were able to spin much more yarn than the hand-driven jennies. In 1779 a jenny-spinner by the name of Crompton succeeded in making a machine which would turn 20 to 30 spindles at once. This enabled English spinners to turn out the yarn even more rapidly. Because of all these improvements the spinners were now turning out much more yarn than the weavers could make into cloth on their simple hand looms.

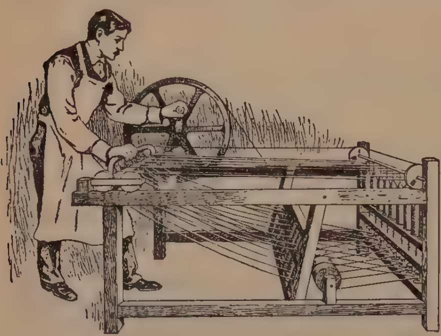

FIG. 119. After Hargreaves invented this spinning "jenny" a laborer could spin by hand from eight to eleven threads at one time, instead of one as on the spinning wheel. Note that the threads are being wound on the upright spindles on the right-hand side of the frame

In the meantime, however, the looms were likewise being improved, though slowly. In 1738 a weaver had invented a "flying shuttle," so named because it could be jerked back and forth by cords much more quickly and evenly than by hand. In 1785 Dr. Edmund Cartwright succeeded in making a weaving loom that would operate by water power. This would have enabled the weavers to use all the yarn which the spinners produced; but although Cartwright perfected his water-power loom in 1787 it was hard to persuade English weavers to use it. So it has been with almost every invention brought about by the Industrial Revolution. People, used to their old ways of doing things, dislike to have to learn new methods, especially if the methods seem complicated and unusual. *Even as late as 1813, or 26 years after Cartwright's invention,* there were only 2400 power looms in use in

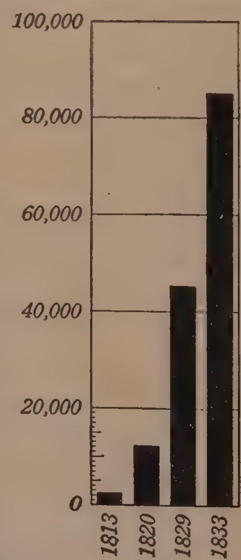

FIG. 120. Increase in the number of looms from 1813 to 1833

all England. By that time, however, many of the weavers were men who had been children when Cartwright was experimenting with power looms, and they were more ready to use the new machines. Of course the manufacturers saw that a loom run by mechanical power would make many times as much cloth as the old hand looms. So after a while the power looms came very rapidly into use, as figure 120 shows.

The gigantic textile industries of today

One hundred and fifty years have passed since Hargreaves and the other English inventors made the first few spinning and weaving machines. What a transformation has come about! Today the cloth for the garments of most people in Europe and America is made by millions of power-driven machines. Throughout these regions hand machines are now seldom found. In 150 years, more change has come about in the textile industry than was accomplished in all the years preceding. Today there are thousands of cotton, woolen, and silk factories in the United Kingdom, in the United States, in Germany, in France, and several other countries (see figure 121). Even agricultural countries like Russia, India, and China have begun to turn to the use of machines in manufacturing yarn and cloth.

The work is not done today, however, by the simple machines that were invented by Hargreaves, Cartwright, and their fellows. On the contrary, it is done by giant spinning, weaving, dyeing, and finishing machines. Each step in the making of cotton cloth, for example, from the time the cotton is picked until the finished cloth is ready for the purchaser, is carried on by marvelous machines.

Of course these machines were not all invented at one time or in one country. Scientists and inventors in England, in Germany, in France, and in the United States gradually improved the first machines and invented new ones. Frequently manufacturers offered prizes to workers who could suggest practicable devices that would do the work in less time and make better cloth. Spurred on by these offers, inventors steadily improved the machines.

Early in the nineteenth century a good hand-loom weaver could produce only two pieces of cotton shirting in a week. With

one of the first water-power looms, a single weaver was able to produce seven pieces of shirting in the same time. After the middle of the nineteenth century improvements were made which enabled a weaver to keep two power looms going. Still later other improvements enabled him to tend four looms, each one weaving more than any one of the preceding looms. Then after 1900 came the invention of even more remarkable attachments for the looms which made it possible for a single weaver to operate 16 looms at one time. Thus the improvement in power looms increased sixteen-fold the number of machines that a weaver could operate. In the meantime similar improvements had been made in the other branches of the textile industry.

FIG. 121. This graph illustrates the widespread use of machines in modern industry today. It gives the number of power-driven cotton spindles used in the leading cotton-manufacturing countries in 1925. Note that the United Kingdom and the United States own more than half of the spindles of all these countries

A modern weaving room with 25 weavers, each tending a long row of power-driven looms, produces as much as 60,000 craftsmen could produce in the days of hand weaving.

This, then, is merely an outline of the industrial revolution as it applied to the manufacturing of yarn and cloth. Space is lacking to describe equally remarkable changes in the manufacture of silk and in the making of garments. Machines have been invented by which complicated designs can be woven in fine fabrics. Even the finer arts of embroidery, lace-making, and drawn work are being carried on mostly by the use of machines. In the garment-making trades, likewise, machines are taking the place of hand sewing. About the middle of the nineteenth century inventors succeeded in making practicable sewing machines. Today cleverly constructed machines make our stockings, dresses, underclothing, suits, overcoats, gloves, and hats.

The second example: the use of machines in making shoes

The making of cloth is only one of the great machine industries in the United States today. Another one which affects all the people all the time is the manufacture of shoes. Shoes are made today in great factories which employ thousands of men and use thousands of complicated machines. But this condition has come about gradually, as in the making of cloth in factories.

In the early American colonies shoes, like cloth and other things, were made altogether by hand. Shoemaking was, indeed,

FIG. 122. On the left, the old-time shoemaker's shop; one shoe a day by hand. On the right, the modern shoe factory; one shoe in twenty minutes by machine

one of the first handicrafts to develop. A shoemaker, Thomas Beard, came from England on the third trip which the *Mayflower* made to the Plymouth Colony. He brought with him the materials of his trade, "hides both for sole and up leathers." He was the first shoemaker in the English colonies. Soon, however, others followed. The shoemaker of those early days was a jack-of-all-trades. Sometimes he was a farmer. Sometimes he practiced other trades, such as sharpening knives or mending furniture. From house to house he went making the shoes needed for the coming year and mending the old ones.

For more than a century the shoes of most of the colonists were made by traveling shoemakers. Gradually, however, some of the more well-to-do shoemakers began to hire others to work for them. Little shoe shops like that shown in figure 122 were built in the towns. In the larger towns several shoemakers might be found working for wages for the owner of the shop. But even in these larger shops, until about the middle of the nineteenth century, shoes were still made by hand.

Then inventors learned to make wonderful machines which would do the work of clever human hands. First there was invented a simple rolling machine, in 1845. This saved much labor and time in preparing the leather for the soles. In the old days the shoemaker sometimes spent a half-hour making the sole leather soft and pliable. By means of the rolling machine, which

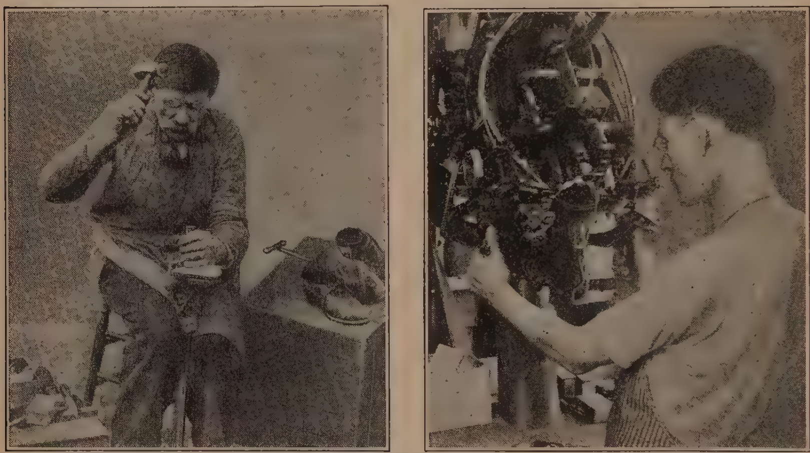

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FIG. 123. The old and the new way of making shoes. Slowly but surely the cobbler who made the entire shoe by hand is disappearing and tenders of shoemaking machines are taking his place

runs the leather between strong rollers, this operation can be performed in about a minute — a great saving of both time and energy.

Many other and more complicated machines and appliances were invented. In 1858 McKay succeeded in making a practicable shoe-sewing machine. This machine sewed the upper part of the shoes to the lower part and stitched on the soles. Previously this work had always been done by hand. The McKay sewing machine worked a great change in the shoe industry. It had fingerlike parts which drew the edges of the upper over the "last" (wooden frame) and tacked them down. This process done by hand requires great care. Hence a great saving was accomplished through the invention of this machine.

These are only two of the scores of machines which have taken the making of shoes out of the hands of the old-fashioned cobbler. In this industry as well as in the textile industry, one invention

led to another. Steadily the machines were improved. As the years went on new machines and new attachments, one by one, took over the separate jobs of the shoemaker. Today more than 150 different machines are used in the making of the shoe. Of course there are still many operations that must be done by hand. It is said that including the operations that can be done by machine and those which still have to be carried on by hand, the making of a shoe includes more than 200 separate steps. And yet, because of machines, a pair can be made in forty minutes.

Figure 123 sums up the industrial revolution in the making of shoes; one shoe a day by hand, one shoe in 20 minutes by machine. A great saving in time and labor, a great increase in the number of shoes produced. In the making of shoes, as in the making of cloth, the amount produced greatly increased with the invention and use of machines.

The third example: an automobile made in two days

We have studied examples of the way in which the invention of machines has completely changed the making of things in the textile and the shoe industry. There is space in this chapter for only one more example: the automobile industry. We shall study briefly how machines have changed the making of automobiles. This is at the present time the largest industry in the United States. The different ways in which automobile manufacturers employ machines provide an excellent illustration of the manner in which machines are made to do man's work.

FIG. 124. Unloading iron from boats at the dock of the Fordson plant

Take the making of a Ford car, for example. On Monday morning at 8 A.M. the Ford ore boats unload iron ore near the factory in Michigan. Wednesday noon, two days later, the assembled, painted, upholstered Ford automobile may be driven away from the factory by its new owner!

FIG. 125. Molten iron from the furnace pouring into ladle cars

What has made this magical performance possible? Machines and power and intelligent planning in a great factory. The story of how this is done is almost unbelievable. But it is true and is a remarkable example of what machines and power and brains can do.

1. *Monday, 8 A.M.* After a trip of approximately 48 hours from Marquette the ore boat docks at the Fordson Plant, at River Rouge, Michigan. Unloaders start removing the cargo, which is transferred twice to get it to the car which fills the blast furnace. The Ford Motor Company makes its own steel. By the use of powerful machinery this unloading takes only ten minutes instead of ten hours.

FIG. 126. Scene in the foundry at the Fordson plant

2. *Tuesday, 12.10 A.M.* Sixteen hours later the ore is cast into bars, or "pigs," and sent to the foundry, where, mixed with certain proportions of scrap, it is remelted. This takes about four hours.

3. *Tuesday, 4.10 A.M.* As the conveyer brings the molds past the pouring station the hot metal is cast into cylinder blocks. These are then taken away to cool and to be cleaned, a process which requires about five hours.

FIG. 127. Cylinder blocks coming from washer to assembly line — Model A Ford

4. *Tuesday, 9.10 A.M.* The casting now goes to the first of its 44 machining operations, all of which are completed in approximately 100 minutes.

5. *Tuesday, 10.50 A.M.* About 10.50 the motor is ready for the assembly line. Mechanics have reduced the time required to assemble the motor to an average of 121 minutes. This includes everything about the motor.

6. *Tuesday, 12.50 P.M.* Except for "running in" the motor to loosen it up, everything is done "on the move," even a test electrically controlled. Then the completed motor passes over a moving conveyer, is loaded into a freight car, and is shipped to a branch factory to be assembled into a finished car.

FIG. 128. Assembling crankshaft to engine — Model A Ford

7. *Wednesday morning.* Arriving at the branch plant, the motor is unloaded and sent to its station on the final assembly line. In four hours the car is ready to be driven away.

8. *Wednesday, 12 noon.* Long before noon the dealer will have taken delivery of the car and paid for it. In the case of "drive-aways" the dealer often brings his customer to the plant and closes the deal then and there. Here is a conversion of raw material into cash in approximately 52 hours. Of this 52 hours, 15 are consumed in shipping and handling. *The engine of the latest model of the Ford car is now assembled in even shorter time—31 hours from the time the ore is unloaded on the dock.*

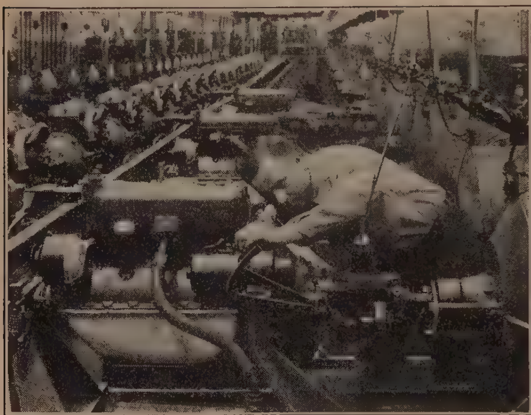

Fig. 129. Testing the motor for transmission noise in a Model A Ford

This example of what one company does shows clearly how it was possible for millions of automobiles to be produced. Indeed, in each of three years—1923, 1924, and 1925—this company alone produced 2,000,000 cars. By means of machines driven by mechanical power and by means of intelligent arrangement of the work in the factory, 7000 automobiles were manufactured each day.

Fig. 130. Model A Ford; scene along final assembly line

In the automobile industry, therefore, as in the making of yarn, cloth, shoes, and other things, machines and mechanical power have brought about *quantity pro-*

duction. "Mass production" is a single phrase that is frequently used to sum up this feature of modern industry. If there were space in this book we could present many examples of mass production in the manufacture of steel, of harvesting machinery, of prepared foods, and of many other things.

What has made Possible this Astonishing Mass Production?

You will be able to think instantly of two reasons for this gigantic mass production. The first is the tremendous amounts of *power* which lift and hammer, transport, cut, and assemble things more rapidly and in greater masses than human muscles can manage. Each of the machines in the Ford plants, like those of thousands of other businesses, is run by mechanical power. Large quantities of electric current are sent to every department of the factory. A workman can bore, fit a rivet, plane, or drill, by simply turning on a switch beside him; electric power starts his machine at once.

The second reason is that the work is done by machines. There are not only machines to do the work formerly done by hand power, but also *machines which make and handle machines.* In one of the Ford plants there is a building covering nine acres. In it are giant drills, presses, boring machines, etc. In it also are two railroad tracks. On one of these, 1600 tons of the finest steel obtainable is brought into the building each day. On the other track 44 carloads of finished automobile and tractor parts are taken out each day for shipment to branch Ford plants. In this one building 1000 different kinds of automobile and tractor parts are manufactured. The materials within this building are handled by nine ten-ton cranes. Railroad cars are switched in and out six times a day.[1]

[1] The information concerning the making of Ford automobiles was obtained from publications of the Ford Motor Company. These facts and the photographs illustrating the processes of manufacture are reprinted through the courtesy and with the permission of the company.

Important Changes in Work brought about by the Industrial Revolution

1. The making of things was transferred from homes to factories

Before engines and machines were invented there were few factories. Almost all manufactured goods were made by hand in the homes of craftsmen. In the later 1700's, however, as the use of machines increased, the craftsmen stopped working in their homes and went to work in factories. There were several reasons for this change. *First*, the machines were so expensive that the spinners, weavers, shoemakers, and other craftsmen could not afford to own them. *Second*, steam engines or water power was needed to run them. Most craftsmen could not afford to provide this mechanical power for themselves. So wealthy men began to build factories, in each of which many machines could be installed and many workmen employed. Hence after 1800, in increasing numbers, most of the spinners, weavers, shoemakers, and other skilled craftsmen of England, the United States, France, Germany, and other countries stopped working at home and went to work in factories. No longer could a man work for himself when he pleased and as many hours a day as he pleased. Instead, the workmen worked on a schedule set by the owner of the factory. In Chapter XXI we shall study more about the way in which the Industrial Revolution affected hours and conditions of work and wages.

2. Work became "specialized"; that is, it was divided among many workmen tending different machines

The second change which the Industrial Revolution brought about in the making of things can be described by the phrase "specialization of labor," or "division of labor." You have already learned that the making of a shoe has been divided and subdivided until now more than 150 machines are used. Each of these machines does a special thing. No one man can run these 150 machines. The labor of making a shoe, therefore, has been divided among many skilled workmen.

In the automobile industry today, as in many other industries, manufacturers pay a man for doing just one job. Many of these jobs can be easily learned, and the worker turns out a much larger amount of work than was possible before. Perhaps you have heard the story of a "mechanic" who applied for a job in a factory and, on being asked what his experience was, replied, "I turned nut 34

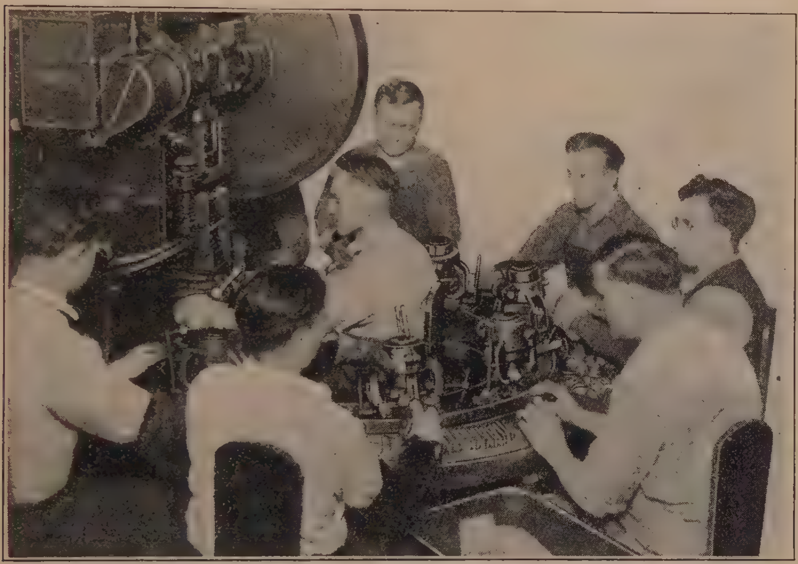

FIG. 131. This picture illustrates how jobs are specialized in the machine industries. As these machines revolve, each of these men does his particular job — a specialized, skilled operation. (Courtesy of the Western Electric Company)

in the Ford shop." And no doubt he did just that, for there are many men in such a factory who stand beside a moving belt and do nothing all day but tighten one nut on the assembled machines as they move slowly past them. In one department of an automobile factory, for example, over 4000 crank cases are manufactured daily by but 22 men. One man feeds the piece of steel into machine No. 1; another man takes the cut piece from the other side of the machine and places it in machine No. 2, which roughly forms the crank case. The workman on the opposite side takes the rough crank case and hangs it on a moving belt. The belt carries it through a heating treatment, from which it is returned for other operations each of which is handled by a special workman.

There is insufficient space, of course, to illustrate how the thousands of jobs in a great factory are specialized, how each man does one thing over and over again, day after day, year in and year out. We have referred to this way of doing things in the making of shoes and automobiles merely because they are representative of a very efficient practice of dividing labor.

3. Machines were "standardized"; that is, the parts were made in uniform sizes and patterns

It was possible to divide labor among many workmen because of another great change brought about by the Industrial Revolution: *the standardizing of machines.* By this we mean that machines and their parts are made exactly alike. A McKay shoe-sewing machine in Boston is like a McKay shoe-sewing machine in Chicago or any other city. If part of the machine goes wrong that part can be supplied from a general shoe-machinery supply store. It does not have to be made to order for that particular machine. In all shoemaking cities there are shops where these parts of machines can be bought. If a machine breaks down it can be immediately repaired. All over the country it is becoming more and more common for all machines of a particular kind to be made just alike, so that broken or worn parts can be easily and quickly replaced. Thus machines are being *standardized.*

Consider some other well-known illustrations. One automobile is like another because its parts have been standardized. For example, its engine is like every other engine in other automobiles of that type; its axles are like the axles on every other automobile of that type; its wheels, its body, its tires, every part of the automobile, are made in standard sizes. If you lose a hub cap, a nut, or any part of any standard automobile you can obtain one like it in almost any large city in the United States, and the new one that you buy will fit.

What is true of shoe machines and automobiles is true of most things commonly used today. Screws and nuts, bolts, hinges, axles, wheels, have been standardized — that is, made uniform in size and shape. Sizes of shoes, hats, suits, stockings, dresses, have been standardized. Telephones and their parts are made exactly alike. All the standard-gauge tracks of American railroads are

laid exactly four feet eight-and-one-half inches apart, and the wheels of railroad cars of all companies are set exactly the same distance apart; thus the cars of any company can roll over the tracks of any other company. In our houses today electric-light sockets and electric bulbs are so standardized that any ordinary bulb will fit any socket. Windows and doors are made to standard sizes. Stairs are set in standard slopes and heights. Timbers are cut in lumber mills to standard dimensions. These, therefore, are examples of standardization.

4. Machines have brought about mass production

The effects of the Industrial Revolution can be summed up by emphasizing again the great quantities in which our manufactured goods are produced today. We have already studied examples of mass production in the textile, shoemaking, and automobile industries. Cloth is woven by the millions of yards. Shoes are produced in millions of pairs. Automobiles now mount each year into the millions. Almost everything we use is made in large quantities. So we speak of our industrial civilization as one in which manufacturing is done on a mass-production basis.

These Changes have done Much to Improve our Standard of Living

The changes brought about by the Industrial Revolution have, indeed, given us a new civilization. It is a civilization of physical comfort. Compared with earlier peoples, those who live in industrial countries today have a high standard of living. They have more plentiful and varied food, better clothing, and more comfortable houses than people had in earlier civilizations. They have shorter working days, more time for recreation, and recreation itself is more varied. As we shall learn in later chapters, means of transportation and communication have been marvelously improved. Things that were luxuries a hundred years ago we consider necessities today. Many things that people for centuries never dreamed of having are now accepted as commonplace and necessary. City sewage systems, electric lights, artificial ice, gas stoves, "movies," porcelain bathtubs, prepared

foods — most of these things our grandfathers, in their youth, had never heard of. Today we feel that they are necessities, that we cannot get along without them.

Is the Industrial Revolution still going on Today?

The Industrial Revolution began about 200 years ago. When did it stop?

It has not stopped. It is going on today in a more startling way than ever before. Every year brings us announcements of new material wonders that modern science has produced. Every year adds to our mechanical control over nature, increases man's physical comforts, speeds up his transportation and communication and makes them safer and surer. In industry, for example, in recent years, new inventions have increased several fold the amount of work which a man can do. In automobile manufacturing in 1925 a man could turn out 3.1 times as much work in a single hour of labor as he could in 1914! Between 1914 and 1925 each worker in the rubber-tire industry also learned to do 3.1 times as much; in great steelworks and rolling mills each man in the same period learned to do 1.5 times as much; in the manufacture of cement 1.6 times as much; in the refining of oil 1.8 times as much. The amount of work that a workman did per hour in other important industries in 1914 had increased from 25 to 50 per cent by 1925.

These facts illustrate our point that the Industrial Revolution is going on today more vigorously than ever before. Great manufacturing companies encourage invention by employing scientists and inventors. Each of our universities encourages its scientists to invent new ways of doing work. Our national and state governments also employ inventors. Millions of dollars are spent annually in the attempt to improve industrial methods.

If there were space in this book, examples could be given of the way in which every one of our great industries has been transformed by the Industrial Revolution. We could show, for example, how the invention of machines has changed the building trades, the making of books, the manufacture of glass, and the construction of household furnishings, utensils, and electrical

equipment. In Chapters XIII to XIX we shall study how machines have changed transportation and communication; in Chapter XXII, how machines have caused the growth of great cities; in Chapter XXIII, how they have revolutionized farming. Machines have changed our whole material civilization — the making of food, shelter, and clothing. They have also changed our recreation, our ways of thinking, our whole way of living.

INTERESTING READINGS FROM WHICH YOU CAN GET ADDITIONAL INFORMATION

Books

*Bachman, Frank P. Great Inventors and their Inventions. American Book Company, New York, 1918.

Interesting and easy to read. See particularly the following chapters: Chapter V (The Invention of Spinning Machines: The Jenny, the Water Frame, and the Mule); Chapter IV (Eli Whitney and the Invention of the Cotton Gin); Chapter VII (Elias Howe and the Invention of the Sewing Machine)

Bishop, A. L., and Keller, A. G. Industry and Trade. Ginn and Company, Boston, 1923.

Chapters XVII, XX, and XXII include illustrated accounts of the place of machinery in modern industry.

*Bridges, T. C. The Young Folk's Book of Invention. Little, Brown & Company, Boston, 1926.

An unusually good reference, telling in Chapter XXIX what machinery does for man.

*Brooks, Eugene C. The Story of Cotton. Rand McNally & Company, Chicago, 1911.

An excellent reference. Chapter XIII (Cotton Manufacturing) has a good description of the steps from raw cotton to manufactured goods.

Burns, Elmer E. The Story of Great Inventions. Harper & Brothers, New York, 1910.

*Earle, Alice Morse. Home Life in Colonial Days. The Macmillan Company, New York, 1919.

Elaborately illustrated and full of rich detail; it is by far the best source given from which to get a picture of home life and industry in colonial times.

Forman, S. E. Stories of Useful Inventions. The Century Co., New York, 1914.

Gibson, C. R. The Romance of Modern Manufacture. J. B. Lippincott Company, Philadelphia, 1918.

Accounts are included of manufacturing in some of our major industries.

*Kaempffert, Waldemar B. (Editor). A Popular History of American Invention, Volume II. Charles Scribner's Sons, New York, 1924.

Part IV, Chapter VI (From Plantation to Loom); Part V, Chapter I (Automatic Machine Tools) and Chapter II (Putting Air to Work).

*Keir, Malcolm. The Epic of Industry (Volume V of The Pageant of America). Yale University Press, New Haven, 1926.

Chapter I (The Age of Homespun), Chapter II (The Coming of the Artisans), Chapter III (The Rise of the Factory System), Chapter VIII (The Hum of the Shuttle), and Chapter XIII (Tanner and Shoemaker).

Marshall, Leon C. The Story of Human Progress. The Macmillan Company, New York, 1925.

Chapter IV (Power and the Machine as Phases of Man's Harnessing of Nature).

Marshall, Leon C. Readings in the Story of Human Progress. The Macmillan Company, New York, 1926.

Chapter XII (The Coöperation of Specialists).

Magazine Articles

"Machines with Nimble Fingers," *Literary Digest*, November 7, 1925, p. 23.

*"Massachusetts — Beehive of Business," *National Geographic Magazine*, March, 1920, pp. 203–245.

Excellent photographs of the use of machinery in the textile, the shoemaking, and the paper industries.

*"The Automobile Industry. An American Art that has revolutionized Methods in Manufacturing and transformed Transportation," *National Geographic Magazine*, October, 1923, pp. 337–414.

UNIT V

TRANSPORTATION AND COMMUNICATION

CHAPTER XIII

INTRODUCTION TO TRANSPORTATION AND COMMUNICATION

FIG. 132. Ties that bind the scattered parts of our country together. (Courtesy of the American Telephone and Telegraph Company)

In Chapter XII we considered the way in which the invention of machines has changed our way of making things. As engines were invented and machines perfected, our means of transportation and communication were revolutionized also. Today our means of transportation and communication are so different from what they were in the days before the steam engine was invented that we speak of the change which came about as the *revolution* in transportation and communication. It is a part of the great Industrial Revolution. We shall tell the story briefly, but it actually covers a period of thousands of years. During that time men struggled to find easier, swifter, and surer means of carrying their goods, themselves, and their messages. How this all happened is told in the next six chapters.

Examples of our Dependence upon Transportation and Communication

In millions of homes this morning, breakfasts were eaten that depended absolutely on ships, trains, motor trucks, the postal service, the telephone, the telegraph — on every kind of transportation and communication. Figure 133 reminds us of the long

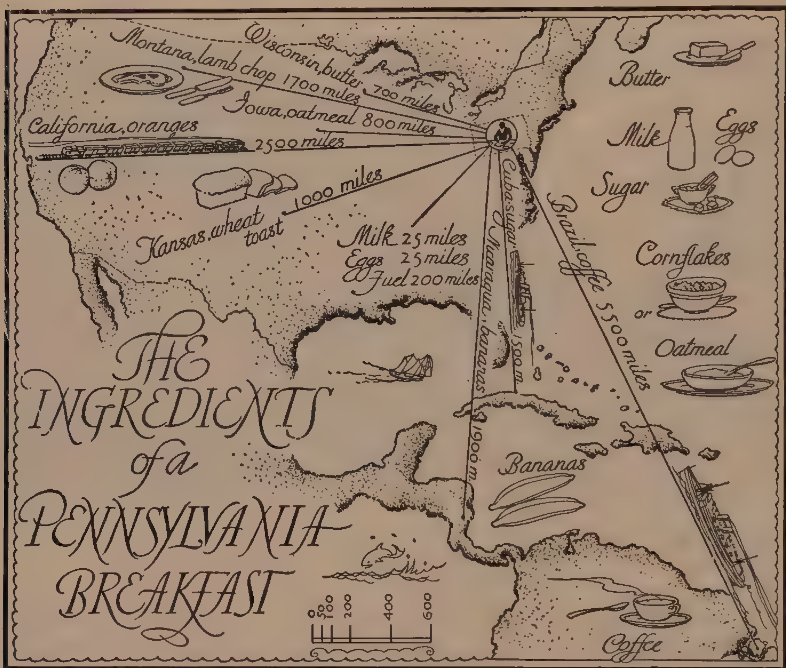

Fig. 133

trips many of our foodstuffs took before they reached the breakfast table: oranges from California, wheat from the Western plains, butter from Wisconsin, a lamb chop from far-away Montana, coffee from South America, sugar from Cuba.

Trace back to their sources the materials of which your clothes are made. You will find that wool comes from Rocky Mountain sheep, cotton from Southern plantations, leather from Texas hides, silk from Japan, and linen from Ireland. Your clothes

were also manufactured somewhere, probably many miles away. If you trace to its source almost any object that you use, you will discover routes of transportation and communication leading out to many distant parts of the world.

Have you ever seriously considered what would happen if every kind of transportation and communication that now makes our life possible were suddenly to cease?

Imagine yourself waking tomorrow morning to find that every way of carrying people or goods and of sending messages, except by human or animal muscles, had stopped. You walk from your house to the corner where your street car usually takes you to your school. The car fails to appear. After standing for a long time on the corner you walk on. You pass taxicabs stalled here and there — some of them protected still by their chauffeurs, but all of them useless. There, at last, is a street car. You hurry up to it, but find it empty. The motorman and conductor don't know when it will go. How deathly silent the streets are! Not even a horse-drawn wagon in sight. Yes, there is one just coming around the block, but only one, for it is a long time since many horse-drawn vehicles were seen on the streets. You wonder what has happened and decide to buy a newspaper to find out, but there is no morning newspaper on the news stand. This is all so strange that you return to your house and find a message that arrived just before communication stopped. It tells you that your mother is sick 100 miles away. You seize the telephone. No sound of life in it. Impatiently you try to attract the operator, but the telephone is "dead." You run to the telegraph office in the next block and write a message, only to have the clerk tell you as you push it across the counter, "Sorry, but the wires are not working."

"I'll try the wireless!"

"Out of order."

"The trains!"

"Not running."

"It's only 100 miles; I'll go by automobile."

"There is none to be had; every motor is stalled."

"Well, even though it is expensive, I'll rent an airplane."

"Not one in operation!"

Imagine *your* helplessness in such a situation! Multiply it by 115,000,000, and you can feel the helplessness of the people of the United States on the first day of such a calamity.

And yet that was the condition of the entire world 150 years ago, indeed, one could almost say 100 years ago. Not an airplane, telephone, telegraph line, not a train, not an automobile in the world. Only human beings with their leg power and the animals upon or behind which they could ride or the boats which they could sail or row. Speak together when far apart? Yes, by writing a letter and sending it by foot messenger or by horseback or coach. Attract each other's attention over long distances? Yes, by sending up smoke signals, by wigwagging flashes of light, by shooting guns. There was no rapid, prompt, and safe long-distance transportation and communication.

We cannot produce or sell Goods without Rapid Means of Transportation and Communication

In Chapter XII we considered the various changes in manufacturing brought about by the invention of machines. Machines have also changed our methods of transportation and communication. In doing so they have helped to make possible the production of things in large quantities. Mass production, of which we learned in Chapter XII, depends not only upon machines, however, but also upon an uninterrupted supply of raw materials. For example, factories that make cotton cloth need large supplies of raw cotton. If these do not arrive when needed, spinning and weaving machines lie idle. So it is with leather for shoes, steel for automobiles, and the materials needed for making other things. Factories must be constantly supplied with the raw materials from which they make goods. The more factories a country has, therefore, the more it depends upon rapid transportation and communication. Countries like China and India, where most of the families live on farms, raising and making nearly everything they need, do not depend on transportation and communication as does a manufacturing country like the United States.

To bring supplies to the factories, we depend upon trains, on

cargo boats, on automobile trucks. Almost all our goods today are made of things transported from distant places. All the raw materials are ordered by letter, telegraph, or telephone and brought together at the factories by means of wonderful systems of transportation — ocean liners, river barges, freight trains, or automobile trucks. From the factories the finished articles are sent out all over the world through these same systems of transportation and communication.

Can you picture in your mind's eye scores of freight trains running through the night from the agricultural communities to the towns and cities, carrying millions of gallons of milk to be used next day by the babies and the grown-ups of our country? Can you see fresh vegetables brought by motor trucks into the great central markets of our cities and distributed in the early morning hours to the wholesalers and the little corner groceries which serve you? Can you see thousands of freight cars, heaped high with coal to be dumped into the yards of great power plants and railroad terminals, ready to run thousands of factories and locomotives?

When you can picture these things and understand how one section of our country depends upon another, you will see what a marvelous system of transportation we Americans have. In the next few chapters we shall study many examples of it.

An Outline of the Long Story of Wheels that made Possible Modern Transportation and Communication

Our transportation system of automobiles, railroads, and steamships is something new in the long development of man. This modern way of binding together into one unified nation millions of people who are scattered over immense territories is something very unusual in the history of the world. The Indians knew no such things. Europeans before A.D. 1700 knew no such things. The ancient civilizations of Egypt and China knew no such ways of transporting and communicating. No people that has ever lived on the earth at any time, or in any place, ever knew transportation and communication as we know it in the modern world.

Man himself was the first draft animal

Human muscles provided the first means of transportation. Man's back, arms, and head were the earliest means of carrying goods from one place to another. The following story is not history. It is the way its author imagined early man may have learned to carry things, but it may have happened just like this.

FIG. 134. Man himself was the first beast of burden, unassisted by even the simplest mechanical aids. (Courtesy of the General Electric Company)

One warm day ages ago "Old Man Neanderthal,"[1] one of the first men of whom we have any record, succeeded in beating a bear to death with a stout oak club. After he had eaten all he could, he realized that "Mrs." Neanderthal, who usually went with him on his hunting trips, had stayed behind at the cave to look after the baby. Old Man Neanderthal knew that she was expecting him to bring in something for dinner, and while he had a man's dislike for carrying bundles, he figured he had better not go back empty-handed. So with much grunting and complaining he carried what was left of the bear's carcass to the cave.

FIG. 135. In many countries today man is still a beast of burden. But he has learned to use mechanical aids to help him. The Chinese coolie increases his muscle power by the aid of the barrow. (Courtesy of the South Manchuria Railway Company)

For a good many thousand years after Old Man Neanderthal lugged home that first bear carcass, he and his children and his children's children knew no other way of moving things from place to place

[1] The "Neanderthal man" is the name given to the primitive kind of man who, according to our scientists, lived in Europe about 50,000 years ago.

except to carry them on their backs or in their arms. In many parts of the world this method of transporting freight is still in use. In China, Africa, India, and Japan, for example, vast amounts of goods are still moved by man power.[1]

After thousands of years of back-packing men learned to use animals as beasts of burden

After a long time men gradually learned to use animals to carry their burdens and to drag their loads. So eager were men to get rid of their heavy loads that they used whatever animals they could bring under their control. If they were all brought together, they would make the most interesting menagerie ever seen in a circus: elephants from India, camels from Arabia and Egypt, donkeys and asses from Palestine, Sicily, and other Mediterranean countries, llamas from the Andean mountains of South America, carabaos (water buffaloes) from the Philippines and Siam, sluggish oxen, shaggy Mongolian ponies, wolflike Alaskan dogs, sturdy mountain horses, and, last but not least, the "wise-eyed, slant-eared mules." On the backs of these and many more beasts of burden the world's commerce moved until recorded times. So it still moves in isolated places where good roads are unknown.

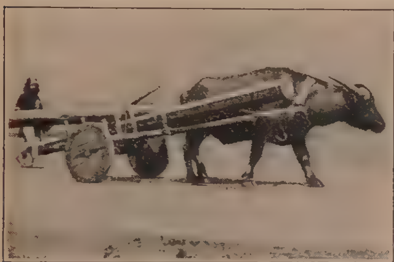

Fig. 136. A crude Chinese cart. (Courtesy of the United States Department of Commerce)

Fig. 137. A Chinese donkey cart in Manchuria. (Courtesy of the South Manchuria Railway Company)

Then came wheels! History cannot tell us the name of the man who invented the first wheels. Perhaps it was some lazy cave man who preferred using his head to straining his back and who, after stumbling over logs many

[1] *Timely Railroad Topics*, No. 47, October 20, 1924. Published by the Atlantic Coast Line, Wilmington, North Carolina.

times, finally got the idea that he could roll a log more easily than he could carry it. We know surely that in very early times men used round logs as rollers to move heavy objects.

FIG. 138. A Chinese chair (passenger) cart. (Courtesy of the South Manchuria Railway Company)

The picture in figure 136 shows a vehicle actually used for transporting goods in China. It illustrates the fact that wheels were, and are now in some countries, simply solid slices cut off logs. Solid wheels, however, warp and split and are quickly worn down by hard, rough ground. They are very heavy and hard to drag or push. So, little by little, throughout man's history, he learned to make circular wooden rims strengthened by heavy planks through the center of which axles were inserted as shown in figure 137. No one knows how many thousands of years passed before men began to use a wooden hub or even spokes and an outer rim with a metal tire. However, sooner or later all the civilized countries discovered how to do so. We are very sure that this must have happened as long ago as several thousand years, because the ancient Egyptians, the Assyrians, and the Chinese had wheeled vehicles which employed the principle of our modern wheel.

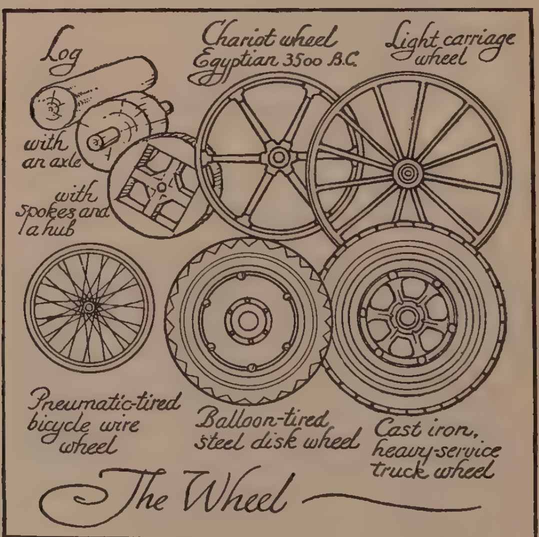

FIG. 139. The story of civilization is the story of wheels. The account begins at the time men learned that rolling a log was much less work than pushing or pulling it

Wheels helped men to transport heavier loads much more

easily than formerly. Human beings tire sooner than do the stronger animals. So men began to harness animals to draw wheeled vehicles. In some countries they used the ox to pull the carts. But the ox though strong was very slow; hence men began to train horses to pull their loads. Horses could not haul as heavy loads as oxen could, but they were able to draw light loads more swiftly. So in many countries the use of horses became widespread.

Better and better carts were made, and wheels were improved. But the speed of transportation and the amount of goods that could be carried were limited by the speed and strength of animals.

Then in modern times men learned to use mechanical power in transportation and communication

Thousands of years passed and people still continued to use their crude and slow-moving vehicles. Then, after A.D. 1750, came the Industrial Revolution, of which you have read. In a hundred years transportation and communication were completely transformed. The power of engines could be applied not only to the work of making things but to the work of moving things as well. So while men were learning to run machines with mechanical power they were also learning to drive locomotives, automobiles, airplanes, and ships by means of it.

In the next four chapters you will study about the revolution in transportation. As you do so, note especially how mechanical power greatly increased the speed and the carrying capacity of transportation. With horses, vehicles could be pulled at the rate of five miles an hour for a distance of forty miles a day. With steam or gas engines, however, locomotives and automobiles could be driven at a speed of 60, even 80, miles an hour. Decade after decade mechanical power increased the load-carrying capacity of man's vehicles. Today one large motor truck run by a single man can carry as heavy a load as 800 men can carry on their backs, and in addition can carry it at least five times as far in the same time. A freight train, with a crew of six men, can transport 20,000 times as heavy a load as these six men alone can carry. In such gains is summed up the story of our recent progress in transportation.

Improvements in the speed of communication have outstripped even those which have been made in transportation. Until 75 years ago men could send messages no more rapidly than messengers could travel by foot or on horseback, by carriage or sailing vessel, by train or steamboat. You will read in Chapter XIX, however, of the astonishing inventions which make it possible for us today to flash words through the air in a few seconds. Before the invention of the telephone, a man's voice could travel through the air only 200 or 300 feet. The telephone carries it 3000 miles; the radio and the wireless telephone carry it 10,000 miles or more.

FIG. 140

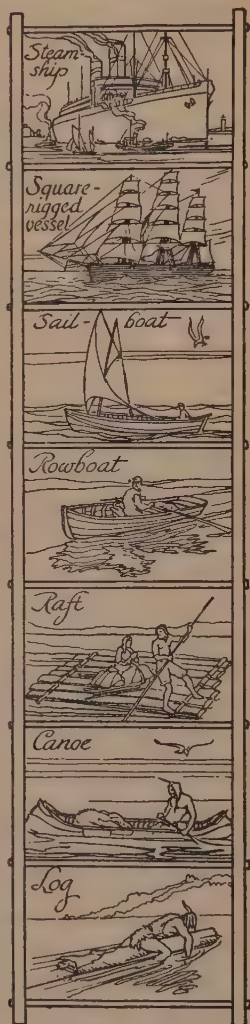

FIG. 141

Cables span the desolate ocean wastes and our messages travel through the mud and shells of the depths never lighted by the sun. . . . Radio messages are sent to ships 1000 miles from land and the ships reply. A broadcast radio message reports the presence of an iceberg in the lanes of ocean travel, and ships change their courses to avoid it. The afternoon prices of the London Stock Exchange are known in New York before luncheon.[1]

[1] Adapted, with permission, from the *World's Work*, May, 1922.

One more incident which illustrates what modern transportation and communication will do for us:

A commission man in Chicago received a telegram from a San Francisco firm, informing him that a cargo of pineapples was due to arrive in San Francisco the following morning. Pineapples are perishable, and a large amount of money was involved. A letter from New York was dropped upon the commission man's desk by the postman, — a letter that was collected from the post box by a motor truck and was sent to Chicago by airplane, — saying that New York had very few pineapples on the market. The broker picked up his telephone and called both San Francisco and New York. From San Francisco he got the price and the quantity. From New York he got an order. When the ship from Honolulu docked in San Francisco the following morning, the pineapples were transferred to waiting refrigerator cars. These a few days later were rolled into the warehouses in New York without the slightest effort on the part of the shipper, the commission man, or the buyer. A check was sent by mail from New York to Chicago. A smaller check was sent from Chicago to San Francisco, and the commission man's bank account was larger by the difference. The checks themselves were returned through the clearing houses by mail, and the deal was closed.[1]

This story illustrates how all our modern means of transportation and communication are used that a food like pineapple may reach your table. Look again at figure 133. The stories of how all these foods reach you may not be exactly the same as that of the pineapples, but in the case of each one there is a *similar* story. Indeed, today few of us stop to think how dependent we have grown upon our new means of transportation and communication.

INTERESTING READINGS FROM WHICH YOU CAN GET ADDITIONAL INFORMATION

Books

Bishop, A. L., and Keller, A. G. Industry and Trade. Ginn and Company, Boston, 1923.

Chapter XXV describes early transportation.

Dunbar, Seymour. A History of Travel in America, Volume I. The Bobbs-Merrill Company, Indianapolis, 1915.

An excellent reference book, especially for the most rapid readers.

[1] Adapted, with permission, from the *World's Work*, May, 1922.

*Huntington, Ellsworth, and Cushing, Sumner W. Modern Business Geography. World Book Company, Yonkers, New York, 1925.

Chapter XIII (Means of Transportation) is an introduction to the complicated network of transportation in our country.

White, Steward Edward. Daniel Boone: Wilderness Scout. Doubleday, Page & Company, New York, 1923.

A story showing the difficulty of travel in the early history of our country.

Magazine Articles

"Racing the 'Black Death' of Alaska for 11,000 Lives," *Literary Digest*, February 21, 1925, pp. 42–48.

When other means of transportation failed, men resorted to a dog team.

*"The South Sea's Grapevine Telegraph," *Literary Digest*, January 28, 1928, pp. 46–53.

CHAPTER XIV

ROADS AND WHEELS IN AMERICAN HISTORY

Roads, especially smooth, hard, enduring roads, do not just happen; men make them. Wherever groups of people live in settled communities, they take care to build roads. One could even trace the progress of civilization by tracing the history of roads.

Whereas primitive people rarely have good roads, civilized people almost always have them. In the past 5000 years several different countries have acquired great territories and built up extensive kingdoms and empires. Each of the great empires of ancient times was made possible partly because the rulers of each one built roads connecting the remote villages and towns with means of easy communication. For hundreds of years, for example, the Chinese emperors governed successfully the scattered communities of their great territory because they kept in connection with their people by means of roads and canals. The Persians, likewise, by building roads held together under one government people who lived hundreds of miles apart. Later the Romans conquered practically all the known world and governed it with the help of their roads. As soon as they had subdued a new region they built straight, well-paved roads which connected it with Rome, the capital city, or with some seaport which led to it. These fine highways gave them rapid transportation and increased their trade and wealth.

What was true of ancient civilizations has also been true of the United States. The building of roads has accompanied the growth of the country. When the first Europeans settled North America the entire continent was a great wilderness. There was not a single well-paved road, only scattered Indian trails, hard to find and harder to follow. Today the United States has about 3,000,000 miles of highways. These serve, with railroads and other means

of transportation and communication, to bind our people together into one nation. To the story of the building of this national system of road transportation we turn in this chapter.

The First Roads to be built throughout American History were merely Wilderness Trails

Of course fine roads were not built in the first days of settling each of the regions of the United States. The colonists were glad enough to have even Indian trails over which to travel. Their first tasks were always to clear the land, to defend themselves against unfriendly Indians, to put up shelters, and to secure food and other necessities of life. This was true of all the first frontier settlements, whether those on the Atlantic coast, those in the Ohio and Mississippi valleys, those on the Western plains, or those on the Pacific coast. It was true indeed throughout more than 275 years, as the colonists settled the different parts of our country from 1607 to 1880 or 1890. No sooner were these first tasks accomplished in any community or region, however, than the people, desiring to trade and communicate with other settlements, built crude roadways between them.

This is what happened in the settlement of every part of our country. In the early 1600's the people settled in little communities in Massachusetts, New York, Virginia, and other colonies along the Atlantic coast. As the years went on people from one village or town moved westward to establish new homes in the wilderness. These new settlements grew into villages and towns, and more people went still farther west, settling new farms and establishing new villages. So the settlement of our vast country went on. Decade after decade people were constantly pushing out to the west and to the south, clearing the wilderness and building farms and villages.

With each new westward movement of the people new trails and roadways had to be built connecting the new settlements with the older ones. And in the meantime the older communities themselves grew larger and more prosperous. As they prospered they improved their roads. Finally, the remarkable national system of roadways which we have today was completed.

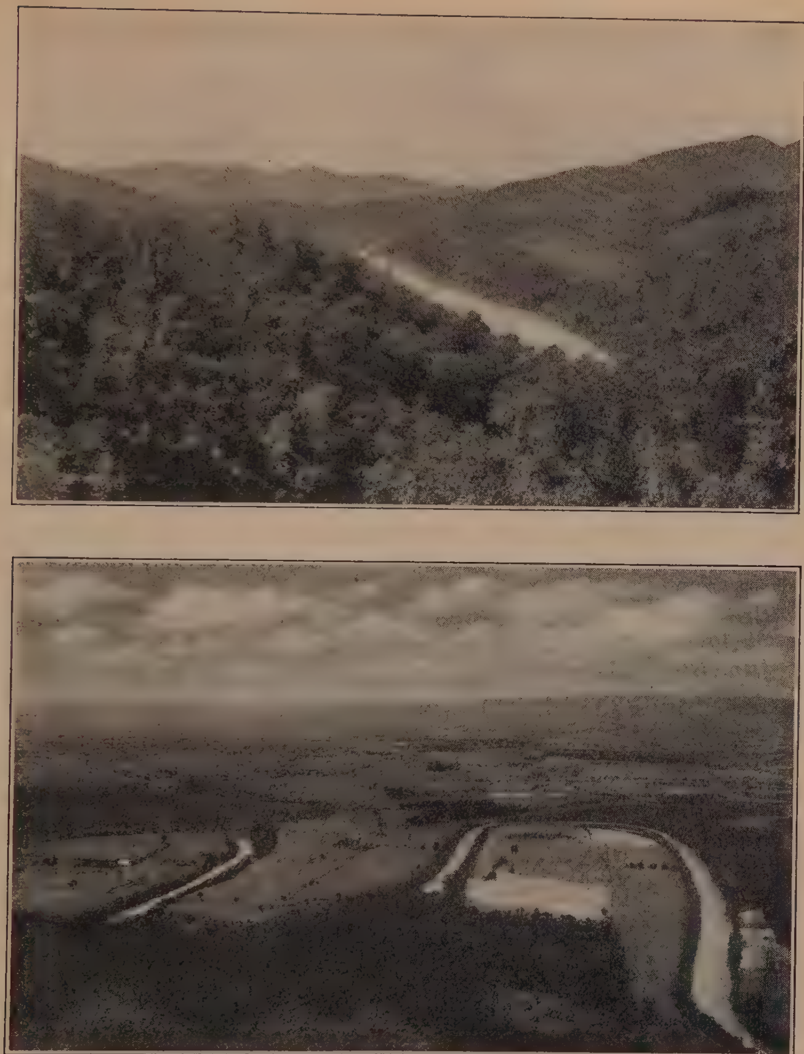

FIG. 142. Three centuries ago much of North America looked like the landscape in the upper picture. No macadam or concrete roads, no paved streets, no grassy parks and playgrounds, no finely cultivated fields, no comfortable farms. There was nothing but wilderness, cut here and there by Indian trails. In 300 years the continent between the two oceans has been conquered, the wilderness cleared, the land cultivated, huge cities built, and 115,000,000 people distributed in thousands of communities, over an area as large as Europe. A century-long revolution in transportation has tied together these communities with 3,000,000 miles of roadway

Daniel Boone's wilderness road: an example of the early pack-horse trail

As an example of the way in which fine highways developed out of trails and paths, consider how the famous Wilderness Road was built from North Carolina across the Appalachian Mountains to Kentucky. The leader in this work was a famous hunter and "trail-blazer" named Daniel Boone. About 1770 a large number of people in North Carolina, hearing of the fine farming land of

FIG. 143. As an artist imagined Daniel Boone blazing a trail through the forest

Kentucky, decided to move there. To move their belongings with them these pioneers had to make their road as they went. Daniel Boone went ahead to pick out the best route. To make even a trail through this country was a difficult task. The land was steep and rocky in some places, and in others marshy and covered with underbrush where men could not walk upright, but must creep through bushes for days at a time. Until a larger trail was cut horses could not pass.

So Boone and his best men went ahead marking, or "blazing," the easiest route by chopping deep notches in trees with a tomahawk. The easiest route was along the more level valleys made by the rivers and smaller streams, and through the gaps, or "passes," between the mountains. Other men came behind the

trail-blazers and chopped down small trees and underbrush, so that a wide enough trail could be made over which people could walk, ride horseback, or drive cattle. Thus the crude roadway followed the natural pathways made by the hills and valleys. Whereever possible the trail-blazers built it beside the rivers and streams, because there the slope was always the most gradual and travel was easiest. A part of the way Boone followed one of the best-known Indian trails, which the white men had called the Warrior's Path. His party pushed on over the mountains until they came to the place where Boonesboro, Kentucky, is now. They stopped here and began to build a settlement. They had accomplished their task — to build the first road from the eastern communities to the inland wilderness lying over the mountains. This was the beginning of the Wilderness Road.

Fig. 144. A train of pack horses loaded with freight. This was the way much of the freight was transported in the days when roads were merely frontier trails

This trail was merely one of the many western trails that developed into crude roadways. Each of these also followed the natural pathways between the mountains. Perhaps you have heard of the famous Cumberland Gap — a deep pass cut through the mountains by the Cumberland River. Through this gap many thousands of pioneers crossed the Appalachian Mountains to reach the new settlements in Kentucky. When the river valleys were unsafe the travelers took the ridge pathways along the crests of the mountain ranges.

Travel on the wilderness trails increased steadily. Pack-horse trains (see figure 144) followed the trail-makers. Sturdy horses were loaded heavily with bags hanging from both sides of the

saddle. For many years the only method of traveling or of sending goods over the mountains to communities like Pittsburgh was by this means. So expensive was this means of transportation, however, that salt cost from \$5 to \$10 a bushel in the early days of Pittsburgh. This was many times as much as it cost in the older communities on the Atlantic coast.

Then Crude Carts, Wagons, and "Prairie Schooners" appeared on the slowly Widening Roads

As the trails were gradually widened and became rough roads, wagons came into more general use and the number of people traveling greatly increased. These first roads were narrow and winding, always rough, and often impassable. The wagons that could hold together in spite of the jolting and straining produced by such travel had to be strong indeed. Two-wheeled carts were often used, as well as sleds and even horse barrows. The latter were large, three-wheeled vehicles like hand wheelbarrows but drawn by a horse.

The westward-moving pioneer needed larger and stronger covered wagons, capable of carrying his family and all his possessions. His possessions included such things as furniture, plows and other farming tools, barrels of water, flour, and food for his oxen as well as for his family.

A wagon, known either as a "prairie schooner" or a "Conestoga wagon" (see figure 145), proved to be the vehicle that best met the needs of the pioneer. This wagon was named for a tribe of Indians in the Conestoga valley in Pennsylvania, where it first appeared about 1750. The floor of this heavily built wagon curved down in the middle so that as the pioneer rumbled along over the rough country, up hill and down, his goods would not tumble out. The white canvas top curved down in the middle even more than the body. For some reason the wagon was nearly always painted in the same bright colors — the underpart of the body blue, the upper woodwork red. With its white top it made a very patriotic appearance.

Often a single Conestoga wagon could be seen crawling along all alone over the plains and hills taking a family with all their

possessions to a home farther west. At other times one could have seen whole caravans of these red, white, and blue wagons stretching out in a long, thin line as they made their way across the prairies and through mountain passes. The deep ruts made by their wheels marked the way for later settlers. The trail of the Conestoga wagons marked out the first path for many of our important highways in use today.

These prairie schooners became famous in American history. For more than a hundred years they were the pioneers' chief

FIG. 145. Travelers on the plains in the days of the "Conestoga wagon"

means of transportation. They were used not only in crossing the Appalachian Mountains about 1800; they also served the restless settlers of the Ohio and Mississippi valleys from 1800 to 1850. They were the chief conveyance of the Forty-niners, who went to California and Oregon for gold and land. For more than a century, wherever men were pushing westward out on the frontier, there was to be found the Conestoga wagon. It came into each part of the country years before the railroad, the canal, or the steamboat. It disappeared as recently as 1880.

It was a crude way of traveling but was a great improvement over the pack-horse and trail method.

In the more Settled Communities Roads were improved and Stage Wagons and Coaches furnished the Chief Means of Transportation

So much for the first building of trails and improved roadways and the rough-and-ready vehicles of the westward-moving pioneers. Between the growing towns in the eastern part of the country roads were being improved and crude stage wagons were serving the citizens as their best means of inland transportation. These stage wagons were used to carry both freight and passengers. Trips between towns were not made at regular times but only when there were freight and passengers to make a load. There were no bridges and the rivers had to be crossed either at fords (shallow places) or in crude ferry boats. If heavy rains made a stream unusually high at the fords, the travelers often had to camp on the bank until there was less water in the streams. Sometimes they waited several days. Travelers expected to be delayed and felt that they had no cause for complaint even though they might be going only short distances.

Fig. 146. As roads improved, the most rapid travel was by stagecoach. Four horses, and sometimes even six or eight, were used to pull them

The following description, written in 1797, shows how bad the roads were even then. "The roads from Philadelphia to Baltimore are, the greater part of the way, in savage desolation. There are many chasms to the depth of six, eight, or ten feet. A stagecoach which left Philadelphia on the fifth of February, 1796, took five days to go to Baltimore. The weather for the first four days was good. The roads were in fearful condition. Coaches were overturned, passengers killed, and horses destroyed by overwork put upon them. In winter sometimes no stage sets out for two weeks."[1]

[1] From Dunbar's *History of Travel in America*. Copyrighted and published by the Bobbs-Merrill Company. Used by special permission.

If a man in Philadelphia, for example, had to see someone in New York, he would write a letter like this and hope that the letter would reach his friend before he did. "I am planning to start on the trip a week from Tuesday and hope I shall see you by the following Monday." Of course, if he did not get there by Monday, then he probably would arrive two or three days later, and that would do just as well. But today! At noon the Philadelphia business man calls his New York friend on the long-distance telephone and says, "I am driving over by automobile this afternoon. See you at dinner." Today we travel a thousand miles from New York to Chicago, for example, in less than a day and are irritated if our train is an hour late. If we ride on an extra-fare train, the railroad company will even refund part of our money if the train arrives late.

FIG. 147. For a coach to become stuck in the mud was a frequent experience. An artist of the time in drawing this picture reminds us that under such circumstances "passengers are requested to get out and walk. One 'gent' particularly objected, but the 'gent' always got out sooner or later." (Courtesy of the Bobbs-Merrill Company)

As the years went on, however, the stage wagons, or stagecoaches, as they came to be called, were slowly improved. They became somewhat more comfortable and safe and were used more and more for passengers and less and less for freight. Four horses, sometimes even six or eight, were harnessed to a coach, and there were regular stopping places where the horses were changed and fresh ones put in. Lines of "through" stagecoaches were established. The United States mail was sent over the country by means of these stagecoach lines. In 1802 unbroken communication was established between Boston, Massachusetts, and Savannah, Georgia, but the trip was long, uncomfortable, and unsafe; it required $22\frac{1}{2}$ days! The following table shows the time taken to cover the different parts of the trip and the fare charged:

	Time	Fare
Boston to New York	4 days	$10
New York to Philadelphia	1½ days	5
Philadelphia to Charleston	15 days	50
Charleston to Savannah	2 days	5
Total Boston to Savannah	22½ days	$70

Today we can travel comfortably by train halfway across the country for an expense of about $70.00, and the trip can be made in less than two days.

These through stage lines were possible in part because of the improvement in the main highways connecting the larger cities. Until almost 1800 these highways had been built and maintained by public money raised in the towns and counties. At that time, however, the population of the towns and cities was growing rapidly. Trade with the new communities of the West was increasing, and there was greater need for roads. Private citizens saw in road-building an opportunity to make money. So they began to construct roads called "turnpikes" and to charge "tolls" (fares) for the privilege of driving over them. Turnpike companies were organized, much as any company is today, to carry on a business which requires more money than a single person can furnish. The business of the turnpike companies was to build roads. Large sums of money were subscribed by private citizens, and thousands of miles of improved road were built. Slowly, therefore, after 1800, better highways appeared in New England, in New York, in Pennsylvania, and in the other middle colonies, and to some extent also in the Southern colonies. In Pennsylvania more miles of road were built than in any other state. Even before railroads appeared (about 1830) 2380 miles of road had been built by private companies in that state alone at a cost of about $8,500,000.

Space is lacking in this book to tell more completely the history of the last hundred years of road-making in the United States. It is enough to say here that as the people of the United States settled the entire continent between the Atlantic and the Pacific they built a vast system of roads. Through every region which they traversed roads slowly evolved: first, in the form of narrow, almost impassable trails; next as better and more traveled cart paths, or rough wagon roads; then as smoother dirt roads;

and finally as well-paved highways. By 1890, therefore, there were fairly good dirt roads to be found in all the states from the Atlantic Ocean to the Mississippi River. Even in the vast region from the Mississippi to the Pacific Ocean there were thousands of miles of moderately hard, smooth roadway over which horse-drawn wagons could be safely driven.

During all that time vehicles also slowly improved. Wagons and their parts were made not only safer but more comfortable. Springs were installed in the wagons used for passenger travel. Wheels became better in appearance and in smoothness of running. Road transportation slowly improved in speed and comfort.

But in all that time there was no change in the motive power on these highways. Road transportation for men and goods was still limited by the strength of animals. In the United States horses did most of man's pulling, although the use of oxen in pulling loads of freight persisted in some regions and is seen occasionally even at the present day. So, although passenger travel on the highways speeded up somewhat, nevertheless, until 1890, five miles an hour, 40 miles a day, was all anyone could hope for even if the roads were good.

The Miracle of Road Transportation — the Horseless Carriage

Then after 1890 came the automobile and within a quarter of a century horse-drawn vehicles almost disappeared!

The very first horseless carriages had been invented in England more than a hundred years before. Those were *steam* wagons. Even as early as 1784 William Murdock, in the employ of James Watt, inventor of the steam engine, had built a steam wagon that propelled itself successfully. He was discouraged from carrying on his experiment, however, by the bitter opposition of Watt, who asserted that the poor roads of the time made impracticable any attempt to use the steam engine for road transportation.

Other men persisted, however, in trying to make practicable steam automobiles. In 1801 another Englishman, Richard Trevithick, built a steam automobile, which on its first trial made a

successful trip of six miles, carrying several passengers. Later he built a second car, which worked fairly well, but he never was able to make his automobile commercially successful. It was about this time, you remember, that Oliver Evans had built his combined boat and wagon — the queer-looking *Oruktor Amphibolos* — and had driven it under its own power through the streets of Philadelphia. Evans thought that this would advertise the possibilities of applying steam to land transportation as well as to water transportation. No doubt it did, for other men both in England and in the United States continued to experiment with steam wagons.

In 1824 an American, William Henry James, produced a passenger steam automobile that would carry twenty passengers. Five years later he built a steam-driven passenger car, which he operated satisfactorily on the streets of New York City. A short time afterwards he entered the employ of the new Baltimore and Ohio Railroad and thereafter devoted his time to the improvement of the railroad steam locomotive.

Each improvement in the steam wagon helped later inventors. This is shown in the inventions of an Englishman, Walter Hancock, who between 1831 and 1836 built several steam automobiles, which ran satisfactorily. Hancock carried passengers between London and Stratford, as many as eleven at a time, at the average speed of nine miles an hour. Later his machine attained the "astonishing speed" of seventeen miles an hour! During five months he made over 700 trips, carried more than 12,000 passengers, and covered 4000 miles. Thus we can be sure that almost 100 years ago inventors had proved that practicable steam automobiles *could* be made. Up to 1860 not less than 60 different inventors had worked at the improvement of the steam-driven automobile.

Steam engines, however, with their big boilers and fuel supplies of coal or wood, were too heavy for light vehicles to carry. After large amounts of petroleum had been discovered and men had learned how to get gasoline from oil, inventors began experimenting with gas-driven engines. They saw the advantage of gasoline used in the lighter engines, and gradually most of them gave up the idea of using steam for highway vehicles.

Then after 1890 the gas engine was successfully used in automobiles

We have already read of the invention of the gas engine. After it had been made practicable inventors began to recognize that gas engines were better than steam engines for small vehicles. They could be made much smaller, and gasoline required much less space than coal or wood. But it took years of thoughtful labor to invent a small and commercially practicable gasoline engine. As early as 1879 George B. Selden, of Rochester, New York, invented such an engine and secured a patent on it. It was not until 1895, however, that the first Selden automobile actually appeared. In the meantime credit for having made the first successful gas-engine automobiles went to other men. Charles Duryea, Ellwood Haynes, and Henry Ford each had perfected a gas-driven car.

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Fig. 148. Charles Duryea, seated in the gas-driven car which he invented in Springfield, Massachusetts, in 1892. This is regarded as "the world's first automobile"

Fig. 149. Contrast this modern automobile with Duryea's made only thirty-seven years before

In the short interval since 1892 there have come greater changes in road transportation than occurred in the entire history of the world before that date. For thousands of years men had depended upon human and animal power to move their vehicles. Then came the steam engine and a half-century of commercially unsuccessful attempts to propel road vehicles by steam power. And then was achieved the startling success of the gasoline automobile.

It is no wonder that the automobile has been called one of the most important inventions ever made by man. When your parents were young the automobile was a plaything and a curiosity. For a time automobiles were a luxury for rich people. They

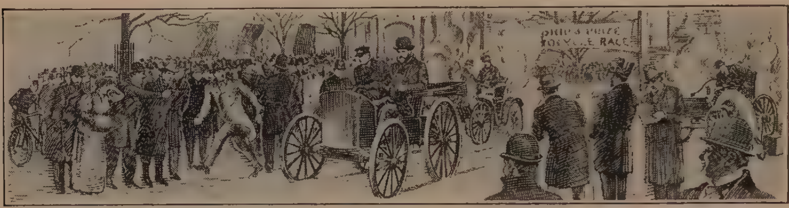

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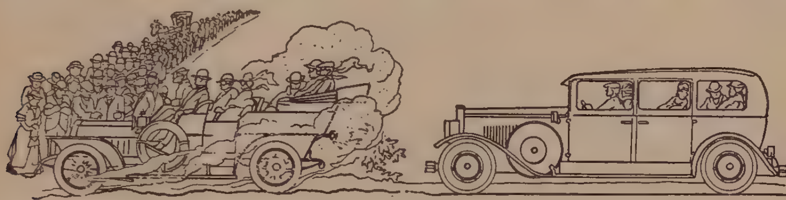
FIG. 150. The picture at the top shows the start on November 28, 1895, of the first horseless-carriage race, run from Jackson Park, Chicago, to Evanston, Illinois, and return. Of 60 proposed entrants only six started the race and only two cars finished. The race was won by Charles Duryea, who drove the distance of 53 miles in 10 hours and 23 minutes, an average of about 5 miles an hour. (Courtesy of the American Telephone and Telegraph Company.) The picture at the bottom shows a recent automobile race in which the winner, De Paolo, drove his car on the speedway track at the rate of 101.1 miles per hour. In 1929 an automobile was driven over a stretch of Florida beach at the amazing speed of 231 miles an hour

were improved so rapidly, however, and are now produced in such great numbers for relatively low prices that today they are considered a necessity by more than half the families in the United States. Today there are more than 23,000,000 automobiles in this country.

The invention of the pneumatic rubber tire

The speed at which automobiles are now driven would not have been possible without other changes in road transportation. Even after an efficient engine had been devised, the automobile was not yet practicable. The tires of the wheels were of hard rubber and most of the roads were bumpy. It was, therefore, impossible to travel comfortably at a rate much over ten miles an hour.

The first improvement came with the making of pneumatic tires. The idea of making a rubber tube, filling it with air, and using



In 1900 there was one automobile to every 18,000 inhabitants in the United States *In 1926 there was one automobile to every five inhabitants in the United States*

FIG. 151. How the number of automobiles has increased

this as a tire for automobiles was first tried out in France. Michelin, a French rubber-manufacturer, first saw the possibilities of using such tires on the automobiles that were to take part in a road race. But no automobile racer was interested. They were all working as hard as possible to improve the engines of their automobiles. To run a car on four cushions of air was impossible! Then Michelin built a car himself and equipped it with air-filled tires. Several of his experiments were discouraging, but each brought some improvement until finally he was able to convince the French manufacturers of the advantage of these tires. People were now more ready to listen to Michelin because several men had perfected the gasoline-driven car, and it awaited only the pneumatic rubber tire and good roads to make it one of the world's greatest means of transportation. Since Michelin's first demonstration pneumatic rubber tires have been greatly improved by him and by many other inventors. Today no passenger automobile is seen without them. In 1926 American-made automobile tires used 281,000 tons of crude rubber.

After 1900 many dirt roads were replaced by macadam highways

The motor car was born into a world of narrow dirt roads. Paved roads existed only in cities; and there were very few miles of these compared with the thoroughfares of our cities today. For the most part the city pavements were of cobblestones, which

Fig. 152. This network of roads has grown up principally in the last 50 years. Note how close and interwoven the roads appear in the eastern half of the United States. Why are there fewer roads in some parts? The relief map (figure 27) may help you to answer this question. (Courtesy of Rand McNally & Company)

give a lasting though very bumpy surface, or of wooden paving blocks, which are not very durable. But outside the cities most roads were not paved.

What a difference now! Thousands of miles of finely surfaced roads. Every city of any size in the country has good boulevards. Fine highways stretch even across the mountains and the plains. There are now 3,000,000 miles of improved roadway in the United States. In the short lifetime of the automobile, say 30 years, 520,000 miles of these roads have been well surfaced. One can drive now almost all the way from Chicago to New York on broad macadam or cement highways. Many of the country roads that have not been paved are kept in much better condition than in earlier

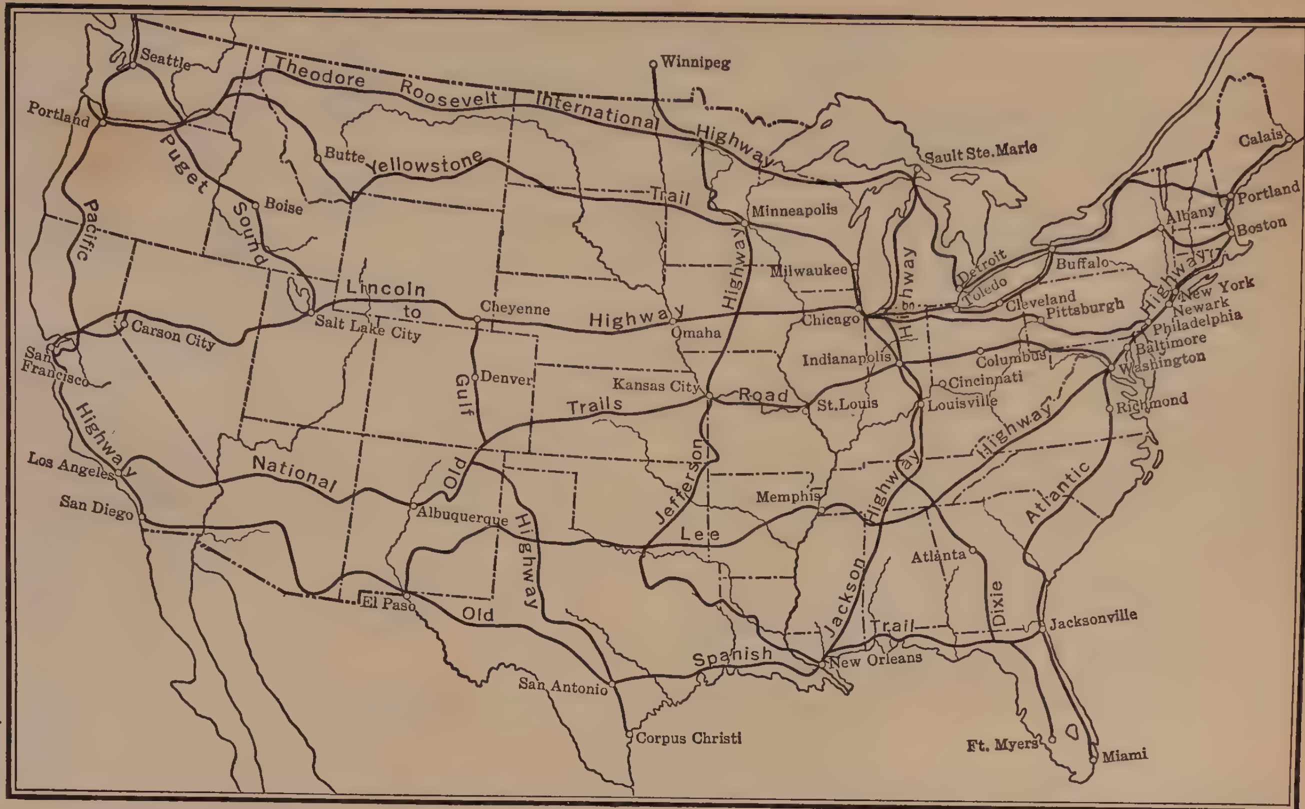


FIG. 153. The motorized highways of the United States. All sections of the country are now connected by fine highways

days, because of the demands of automobilists for smooth roads. One of the greatest services that the automobile has rendered is to bring about the construction of millions of miles of good roads. The United States now spends more than $1,000,000,000 a year on road improvement. It is a good investment because good roads not only greatly increase our safety and our comfort but also bind our nation together.

Americans have become the Greatest Automobile Travelers in the World

No people in the world's history ever traveled as much as Americans do now. This is largely because of the automobile. Thousands of our people live in the suburbs and come to work in the cities in automobiles. They travel from their homes to their work in factory or office. The working day of most of the people

Year	Number of Cars
1900	8,000
1906	77,000
1910	458,000
1915	2,310,000
1920	8,226,000
1925	17,513,000
1926	22,137,500[1]

Fig. 154. Number of automobiles in the United States, 1900–1926.[2] (Courtesy of the *New York Times*)

	Total	Number of Persons to Each Automobile
World	24,600,000	361
United States	20,051,000	5
United Kingdom	816,000	55
France	735,000	53
Canada	716,000	13
Germany	323,000	193

Fig. 155. Number of automobiles in the world in June, 1926.[3] (Courtesy of the *New York Times*)

[1] December, 1926.

[2] It is estimated that 1,625,000 cars were so worn out in 1926 that they were discarded.

[3] Automobiles in December, 1926:

World	27,500,000
United States	22,137,500

of the United States has been reduced in the last 100 years from twelve or fourteen hours to seven, eight, or nine hours. We have more time for pleasure trips than Americans had 100 years ago.

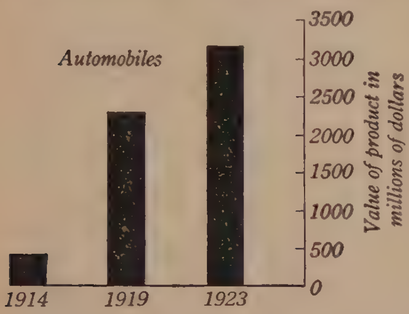


FIG. 156. This graph tells the history of automobiles in millions of dollars of production from 1914 to 1923 [1]

As you stand by the side of any road near a small town or a city, automobile after automobile passes you, particularly during the leisure hours of most of our people. In the good old days, not so long ago for most of us, to take a trip ten or twenty miles away from home was a rare event. Indeed, in many parts of the earth even today people live their whole lives without traveling more than ten miles from the place where they were born. But in the United States we think nothing of a trip of 200 miles in a day, or even in a half-day. In the evening after dinner we run over to the next city to call upon relatives or to go to the "movies" or the lodge meeting. The automobile, therefore, has increased enormously the extent to which the American people move about.

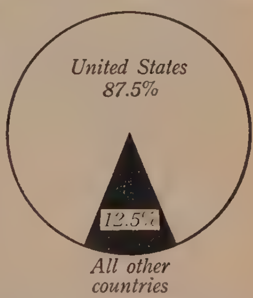


FIG. 157. Who produced the world's automobiles in 1925? [1]

There are now so many automobiles in the United States that every man, woman, and child in the country could be carried at one time by auto. More farmers have automobiles than have water piped into their houses. There are so many cars in the United States that if we tried to put them at one time on the Lincoln Highway, which stretches about 3300 miles from New York to San Francisco, we should have to place them 25 abreast.

Not only do Americans travel in their own automobiles, but they make great use of public motor busses as well. In the spring of 1922, twice each day for a month, the residents along the road

[1] From *Facts and Figures of the Automobile Industry* (National Automobile Chamber of Commerce, New York City, 1926).

from Oakland to Los Angeles, California, noticed a large, white, luxuriously furnished automobile bus passing their homes. They noticed it so often that they began to wonder how many busses of this same kind were running. They discovered that there was only one, and that this one had spent the whole month in making continuous trial trips between the two cities in order to learn how much it would cost to operate busses like it on that line. In the very short time since those first trial trips the motor bus has come into operation all over the United States.

The coming of the motor bus and of the motor truck is the salvation of the transportation problem for many of our communities. We do not know the exact number, but many thousands of these towns and villages are not connected in any way by railroad lines. In Indiana alone there are nearly 700 communities which have bus service and no other means of transportation to other parts of the state or country. According to the National Automobile Chamber of Commerce, in October, 1926, there were 70,000 motor busses in the United States. Nearly 1,000,000 children are taken to school each day in motor busses.

The latest development is a transcontinental bus service from Los Angeles, California, to New York City! Experiments have even been made of running sleeping-car busses between some of our distant cities.

The Automobile is changing the Lives of People in the United States

The farmer's life has been completely changed by the motor car. In 1925, in the United States,

4,300,000 motor vehicles were owned on the farms;
3,800,000 of these were passenger cars;
500,000 were trucks.

No longer is the farmer a backwoodsman, leading a lonely and isolated life. A trip to the town or to the city 50 miles away is a common occurrence. Twenty miles used to mean a day's journey. Now, in the motor car, it is less than an hour's drive. The farmer goes in to town easily whenever he wishes to buy supplies, to do business, to go to the movies, or just to "see folks."

Furthermore, the farmer can haul his crops to market in one tenth of the time the old pair of horses required. Good roads and the automobile motor truck make it possible for perishable farm crops to be taken to market in cities even 100 miles away. Hence, land that used to be unprofitable for farming because it was too far from the railroad is now valuable.

The automobile has also helped to give country children better education. Country people are building fine consolidated schools in villages and towns. One hundred years ago the pupils walked

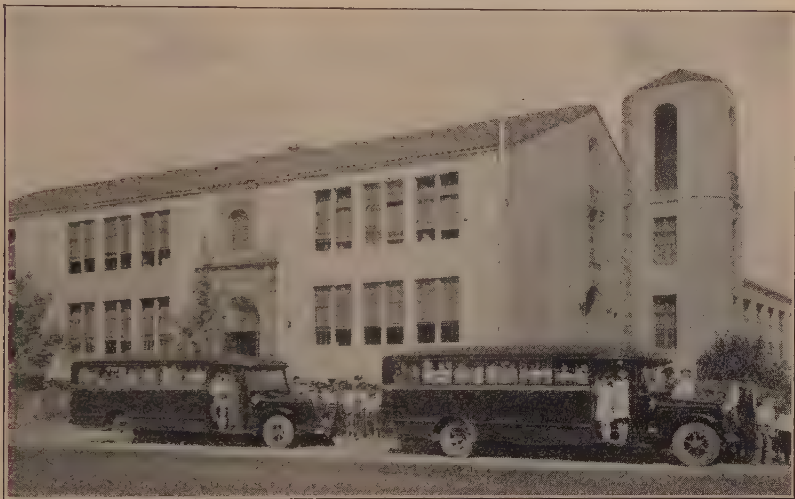


FIG. 158. Automobile busses bring pupils to and from many of the consolidated schools. (Courtesy of the International Harvester Company)

to school or rode to it on horseback. Each little village had to have its own little school, for the pupils could not travel ten or fifteen miles each way every day. It was hard to get good teachers, for they were poorly paid. Today the school bus makes its daily trips through the back roads and main highways of the township and brings the children rapidly and easily to the new consolidated school. These schools are better in every way. They have better buildings, better teachers, better recreation, and a finer social life.

The way people live has also been greatly changed by the automobile. People can now live in the suburbs and drive into the city to their work. People who now live in the city can drive out into the country for recreation over the week-ends. The automo-

bile has improved our health by making it possible for us to have more recreation. It saves us much time and helps us to accomplish much more in a day than we could without it. Bus lines take us from city to city or out into the country or to the seashore or the mountains.

This, then, completes our brief outline of one part of the story of roads and wheels in American history. We have seen how our people from the time of the earliest settlements to this very day

FIG. 159. Thousands of cars are parked daily on the streets of our larger cities. No problem of city traffic is more difficult to handle than that of "Where shall we park?" (Courtesy of the National Automobile Chamber of Commerce, New York City)

have been road-builders. We have learned that all great civilizations have depended upon systems of smooth roads. The people of no country which extends over vast territory can become a unified nation except by means of fine systems of transportation and communication that tie them together. In this chapter we have studied merely one of these important ties that bind our people together. In the next chapter we shall study another — railroads; in Chapters XVI and XVII two others — water and air transportation. Our knowledge of the ties that bind us together into a unified country, however, will not be complete until we have also

studied how there has been developed in the United States a nation-wide system of communication — postal service, telegraphs, telephones, and wireless. Today an industrial nation like the United States, scattered over a vast territory, needs all these means of transportation and communication.

INTERESTING READINGS FROM WHICH YOU CAN GET ADDITIONAL INFORMATION

Books

Bishop, A. L., and Keller, A. G. Industry and Trade. Ginn and Company, Boston, 1923.

Chapter XXVI (Turnpikes and Canals) discusses the first road-building epoch in American history from 1800 to 1830.

*Bridges, T. C. The Young Folk's Book of Invention. Little, Brown & Company, Boston, 1926.

Chapter XI (Roads and Bridges) and Chapter XVII (The Development of the Motor Car) the pupil will find well worth reading.

*Brigham, Albert P. From Trail to Railway through the Appalachians. Ginn and Company, Boston, 1907.

Dunbar, Seymour. A History of Travel in America (4 vols.). The Bobbs-Merrill Company, Indianapolis, 1915.

A committee of the best readers might search through this excellent source for material to report to the class.

Earle, Alice Morse. Stage Coach and Tavern Days, pp. 223–252. The Macmillan Company, New York, 1900.

Hamilton, J. G. de R. Henry Ford. Henry Holt and Company, New York, 1927.

Hulbert, A. B. The Paths of Inland Commerce (Volume XXI of The Chronicles of America), pp. 44–61, 116–133. Yale University Press, 1920.

A good book for the best readers.

*Kaempffert, Waldemar B. (Editor). A Popular History of American Invention, Volume I. Charles Scribner's Sons, New York, 1924.

Part I, Chapter IV (The Rise of the Automobile).

*Keir, Malcolm. The March of Commerce (Volume IV of The Pageant of America). Yale University Press, New Haven, 1927.

Chapter IV (Landways and Waterways); Chapter XVI (A Nation on Wheels).

Magazine Articles

*"A Highway under the Hudson," *World's Work*, September, 1927, pp. 554–562.

"Bumping a Soft Spot at 214 Miles an Hour," *Literary Digest*, March 10, 1928, pp. 54–63.

*"Early Nightmares of the 'Horseless Carriage,'" *Literary Digest*, December 11, 1926, pp. 58–69.

"Killed and Wounded by Motor Traffic: 725,000," *Literary Digest*, June 19, 1926, pp. 53–56.

"The Auto's Toll of Lives," *Scientific American*, March, 1925, pp. 152–154.

FIG. 160. It is hard for us to believe that only about 100 years ago a tiny railroad train like that shown in the upper picture was so rare that people actually drove out in their coaches to watch it pass. The horses seem even more surprised than the passengers. Compare the size of the locomotive shown in the upper picture with that in the lower one. What other differences do you notice? (Courtesy of the Central Steel and Iron Works, Massillon, Ohio (upper picture) and the New York Central Railroad (lower picture))

CHAPTER XV

THE RAILROADS: OUR CHIEF CARRIERS

In 1820 there was not a mile of steel railroad track in the United States. In 1920 there were 250,000 miles. In a century mechanical power brought about a revolution in rail transportation as well as in road transportation and in manufacturing.

No sooner did James Watt succeed in making a practicable steam engine than attempts were made to use it in propelling vehicles both on roads and on rails. So the story of the locomotive and the railroad parallels that of the steam wagon and motor highways.

As we have learned, the early experiments with the steam automobile were not practicable for two reasons: first, roads were too rough at that time; second, the steam engine, necessarily bulky and heavy, was not suitable for small road vehicles. English and American inventors solved the problem of rough roads, however, by using rails. They saw that on smooth and level tracks a single steam locomotive could pull very heavy loads and at much more rapid speeds.

But it was nearly 50 years after Watt's successful completion of the steam engine before locomotives and steam railroads were practicable. Then, in 1824, a locomotive designed by George Stephenson, an English inventor, succeeded in hauling a train of cars from Darlington to Stockton, England, a distance of about fourteen miles. Four years later, in 1828, a similar experiment was successful in the United States on the first tracks laid by the Baltimore & Ohio Railroad. After that, steam locomotives were rapidly improved and railroad tracks built in many places.

To us the railroad trains of 100 years ago look like toys. How tiny they were and what funny engines and cars! Figure 161 shows the *De Witt Clinton*, one of the first locomotives, with its "wood car" and three coaches. Together they were no longer

than one of our modern locomotives with its coal tender. The following story of the first trip of the *De Witt Clinton* gives us a glimpse of railroading a century ago.

Contrasts in railroad travel 100 years ago and today

One August day in 1831 the *De Witt Clinton* started from Albany, New York, on its first trip — one that proved to be memorable. The conductor, or "captain," as he was called, rang a huge bell, the engineer threw in the throttle, and the engine

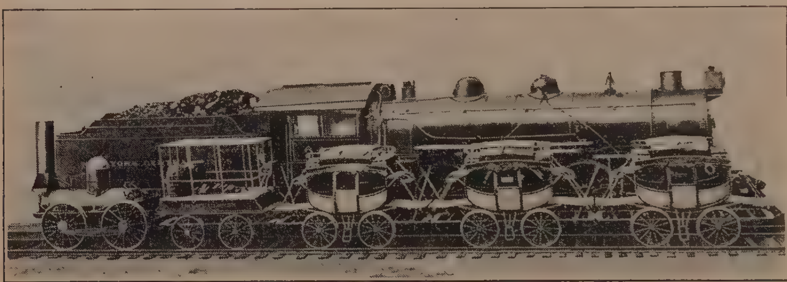


FIG. 161. Growth in the size and power of locomotives is illustrated by this comparison of a modern locomotive and its coal tender with the original *De Witt Clinton* locomotive and train of coaches. (Courtesy of the New York Central Railroad)

jumped forward. The train did not start all at once, however. First one car started and then the next, for each was attached to the one in front of it by an iron chain.

Even the captain was unprepared for what happened. When the engine started, the tender yanked the first passenger coach forward with a jerk. The captain was snapped backward out of his seat, but luckily seized a roof support just in time. The passengers, used to the slow movements by which horses get under way, were taken completely by surprise. As the first car was jerked along the rails men and women were thrown backward over seats and piled in heaps on the floor.

After a few minutes the whole train got straightened out and rolled on fairly smoothly, when suddenly more trouble appeared. The engine burned wood, and soon the smokestack was belching clouds of smoke and a rain of sparks. The sparks blew out in all directions and dropped among the passengers. The first three coaches were covered with roofs, and so only a few sparks blew in

through the side openings. Imagine, however, the havoc created on the uncovered cars behind. Men's coats and hats and women's clothing burst into flames. Some of those on the rear cars raised their umbrellas against the clouds of smoke and fire. By the time the train had rolled up moderate speed each passenger had made of himself a volunteer fireman, extinguishing the conflagration on his neighbor's back.

When the train approached the water tank that had been placed beside the track to supply the engine with water, the engineer threw on the brakes, and to his astonishment and great pride the machinery worked to perfection. But with what tragic results! The tender crashed into the engine, the first coach into the tender, and so on throughout the length of the train. Passengers, in the meantime, were thrown in every direction.[1]

What a contrast that first trip of the *De Witt Clinton* was to the run of one of our speedy and luxurious trains today. When a train starts from the station, do we expect to be thrown out of our seats or to be hit in the face with a rain of sparks? No, of course not. Many engineers pride themselves on the fact that they can start a heavy train of ten or fifteen long passenger coaches and Pullmans so evenly that passengers will not know they are moving — unless they "look at a post." The story is vouched for as true that recently a California transcontinental train pulled out of the Northwestern Station in Chicago so smoothly that a Pullman porter, who should have been on board it, was left standing beside its tracks unaware that it had gone! And as for stopping these huge vehicles, an engineer today by means of air pressure can apply the brakes to the wheels of every car on the train at the same instant. The passengers recline in comfortable upholstered chairs. They are protected from fire, wind, snow, or rain by large plate-glass windows.

Today the busy business man can leave New York at 2.45 in the afternoon on the *Twentieth Century Limited* or the *Broadway Limited*, and arrive in Chicago the next morning at 9.45, transact business for several hours, and be back in his New York office by 10 the following morning.

[1] Adapted from Dunbar's *History of Travel in America*. Copyrighted and published by the Bobbs-Merrill Company. Used by special permission.

The First Experiments in Railroading

But to understand this change in railroad travel we must go back to the beginning of the history of railroads, that is, to about 1830. Recall that at that time one of the most important needs of the people of the Eastern states was to provide highways to join their communities. Roads were being built rapidly by private turnpike companies and by state and county governments. Stagecoaches were humming on these improved stone roads. People were traveling and larger and larger amounts of freight were being carried between villages, towns, and cities. The business men, however, demanded faster and more powerful means of transportation.

Fig. 162. A drawing made from a description of a "sail car," amusing but commercially impracticable. (Courtesy of the Baltimore & Ohio Railroad)

To satisfy the need for better transportation inventors were experimenting with various kinds of "railroads." The first ones were what the name implies—roads made with rails for horse-drawn carriages. The tracks were crude affairs, built of stone blocks or timbers with little iron strips attached upon which the wheels moved. The Baltimore & Ohio Railroad, the first passenger railroad to be built, was originally intended for horse-drawn vehicles. Both in England and in the United States such cars were being used to transport stone from quarries and ore from mines. As the years went on, horse-car tracks were built in towns and cities for passenger transportation.

Many curious experiments were tried on the first crude rails. One of these was the "sail car." It was found that a sail car could be moved in the high wind on smooth plank rails (see figure 162), but no one really expected to be able to propel such cars up hills or over the mountains. And of course no one did.

Transportation that depended upon animals or the wind was too slow and uncertain for the needs of the growing cities. People turned to the steam engine to give them rapid and more powerful transportation. By 1830 several inventors had made steam locomotives that pulled trains successfully. One that attracted much attention was invented by Peter Cooper and was called the *Tom Thumb* (see figure 163). Cooper was one of the first inventors of the United States to succeed in using the steam engine to propel heavy cars on rails. The *Tom Thumb* was used on the Baltimore & Ohio Railroad. The "B. & O." was then only thirteen miles long.

The Stagecoach Proprietors of 1830 tried to prevent the Building of Railroads

One group of business men was greatly disturbed over the success of the builders of steam locomotives. These were the owners of the stagecoaches that carried passengers and freight over the new turnpike roads connecting Philadelphia, New York, Boston, and the other Eastern cities. These men saw that if rapid steam transportation should be successful, it would injure their profitable stagecoach business. They decided, therefore, that they must convince the people that horse-drawn coaches could travel as rapidly and safely as steam locomotives. So one of them challenged Peter Cooper to drive his "steam horse" in a race with a real horse. Cooper accepted the challenge. "When the word go was given . . . the big gray horse chosen to cast ridicule on the clattering engine sprang away on the instant and speedily obtained a lead of about a quarter of a mile. Finally the engine got up enough steam to move ahead. Slowly it gained and after several miles overtook the wagon on the other track. The driver lashed his horse furiously, and for a time the animal actually drew his load at a speed equal to that of the engine. Slowly, however, he lagged behind and it appeared that victory was about to perch on the banner of Progress when suddenly something went wrong with the locomotive. A leather band had slipped from its wheel. The engine slowed down. Desperately Cooper tried to replace the flapping band, even injuring his hands

in his foolhardy attempt. All in vain, however. The engine stalled, the horse forged ahead, and finally won the race decisively."[1]

So the live horse beat the steam horse and cautious people continued for some time to depend upon the stagecoaches and upon horse-drawn cars. For many years, indeed, the proprietors of stagecoach lines continued to secure a very large share of the passenger

FIG. 163. The race between Peter Cooper's *Tom Thumb* and the stagecoach proprietors, August 30, 1830. The locomotive weighed less than a ton and had only one horse power. (Courtesy of the Baltimore & Ohio Railroad)

and freight business. Gradually, however, improvements were made in locomotives, and within a few years regular speeds of fifteen or twenty miles an hour were attained by steam trains. Coaches were made longer and safer, trains ran more and more on schedule time, and people began to have increased confidence in them.

The First Railroads came just when Eastern Cities were competing for Trade in the Ohio valley, 1820–1850

During the 30 years before the invention of the *De Witt Clinton* and *Tom Thumb*, Americans living in New England, eastern New York, Pennsylvania, and New Jersey had been moving westward over the Appalachian Mountains to find homes in the fertile

[1] Adapted from Dunbar's *History of Travel in America*. Copyrighted and published by the Bobbs-Merrill Company. Used by special permission.

land of the Ohio valley. By 1820 (see figure 164) people were living even as far west as the Mississippi River. Ohio, Illinois, and Indiana had been surveyed as states and had been admitted

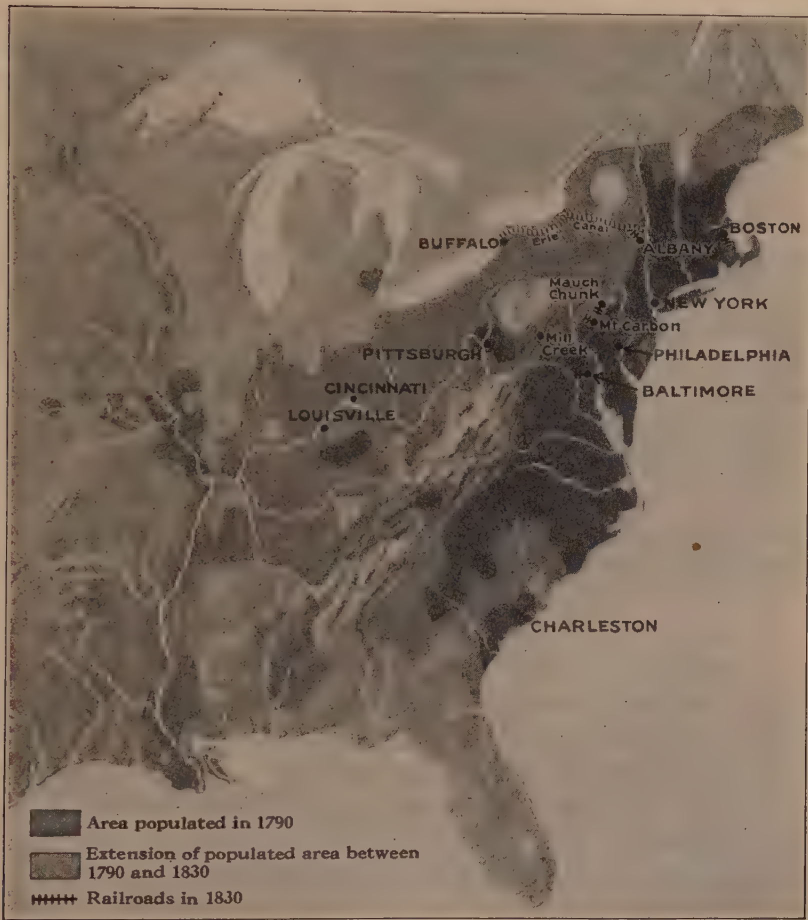


FIG. 164. The darkest shading on this map shows the frontiers of 1790. The next lighter shading shows how the growing population spread out until by 1830 it had reached even beyond the Mississippi. Note that the Erie Canal had already been constructed. There were only 23 miles of railroad at that time

into the Union. Several hundred thousand men, women, and children were living in the regions west of the Appalachians. These people were dependent upon the Eastern cities — New York, Philadelphia, Boston, and Baltimore — for tools, household

utensils, farming implements, nails, drugs, and other necessities which they could not produce in the wilderness. The Eastern people, in turn, wished to secure the furs, foods, and other products of the frontier.

The race of the Eastern cities for this Ohio valley trade began shortly after 1800 and continued for many years. The business men of New York, Philadelphia, and Baltimore struggled to be the first to cut through the Appalachian Mountains with railroads, better roads, and even with canals, as you will learn in the next chapter. Such difficulties as mountains make people try to invent ways to overcome them. In some places the Appalachians were nearly 3000 feet high. In others, as in the Mohawk valley in northern New York State, they rose only a few hundred feet. The location of the new railroads and highways followed, therefore, the river valleys and the more level places. In 1830 there were only 23 miles of railroad in all. After this date little stretches of railroad were built joining various towns and cities in different parts of the Eastern states. Along the valleys of the Hudson, the Susquehanna, and the Delaware, through the flat Mohawk valley, many small pieces of railroad track were built.

These little railroads were not built all at once as a part of a great national plan. Instead, most of them were constructed by local companies formed in particular cities and towns to establish railroad communication with other cities and towns. This was the way in which railroads were built for more than 30 years.

As a typical example, consider how Albany and Buffalo, New York, 365 miles apart, were connected by rails. It required eleven short railroads to cover the distance between these two cities, and each was built by a separate company. The business men of Albany and Schenectady built the first of these tiny railroads, the Mohawk and Hudson, seventeen miles long. A few years later other companies had extended the tracks from Schenectady to Utica. In the meantime, from the western end, Buffalo companies were building tracks eastward toward Albany. Year by year the gap between these stretches of railroad was cut down. Finally, in 1842, railroad track had been laid all the way from Albany to Buffalo, but it was owned by eleven different companies. Meanwhile other companies were building tracks along the banks of

the Hudson River from New York to Albany. By 1851 one could travel all the way from New York to Buffalo by rail.

About the same time the business men of Ohio, Illinois, Indiana, and other "Western" states were also building railroads. Even west of the Mississippi River farmers and business men were joining hands to build their little local pieces of track. By 1860 one could travel and ship goods by railroad from the Eastern cities to Chicago and the other new cities of that section.

How wasteful this way of building railroads was! Each company had built its roads according to its own plans. Many differences occurred, even in the width of the tracks. Some were four feet six inches wide, some four feet eight inches wide, some even five and a half feet wide, each according to the desires of the builders. This meant that the wheels of the cars or locomotives which ran on one stretch of track would not fit the next one. If you had traveled by rail between Albany and Buffalo 75 years ago you would have had to change cars eleven times. The difference in the distance between the rails was one reason for this. Think what this meant in shipping freight. Think of the amount of handling and the chance of breaking, to say nothing of the delays. Do you see how the need for standardization in railroading was as great as in machine-manufacturing?

Of course such a wasteful system of railroading could not last long. By 1870 wealthy business men formed large companies and bought up the little separate railroads. These they combined into great railroad systems. It was in this way, for example, that, about 1870, Cornelius Vanderbilt bought up the little railroads between New York City and Buffalo and joined them into the railroad system now known as the New York Central. Later the same company bought many other little railroads in the Middle West, and today the New York Central system joins New York City and Chicago. With many branch lines, it makes up a system of several thousand miles of track.

In this consolidation, or joining together, of many railroads was illustrated another important example of standardization. The width of the tracks for all these railroad systems was made the same—four feet eight and a half inches. This permitted the locomotives and cars of any one railroad company to roll over the

tracks of any other company. So standardization in railroading, as in the manufacturing industries, brought about a great saving. It did away with the necessity of having passengers change cars and with an enormous amount of loading and unloading of freight.

In 1869 Railroads joined the Atlantic and the Pacific

While the railroads were being built in the eastern part of the United States settlers were pushing out into the vast plains and mountains beyond the Mississippi. As late as 1870 people were

Fig. 165. Compare the two locomotives shown in the figure. The small one was brought around Cape Horn in a sailing vessel shortly after 1850, landed at San Francisco, and was used in the "gold rush" region of California. The other is one of the modern locomotives now used on the Southern Pacific Railroad. (Courtesy of the Southern Pacific Railroad Company)

still moving and settling new homes westward. Distant California and Oregon were growing. The great prairies between the Mississippi and the Rocky Mountains were slowly filling up with people. These far-off regions needed some link to connect them with the East. Highways were still poor, and horse-drawn vehicles were slow and could carry little freight. Valuable, bulky freight had to be transported by ocean vessels around South America for delivery in settlements on the western coast. (See, for example, the small locomotive shown in figure 165, which was brought around Cape Horn by boat.)

People began to recognize the importance of having a railroad from coast to coast. They saw that goods could then be

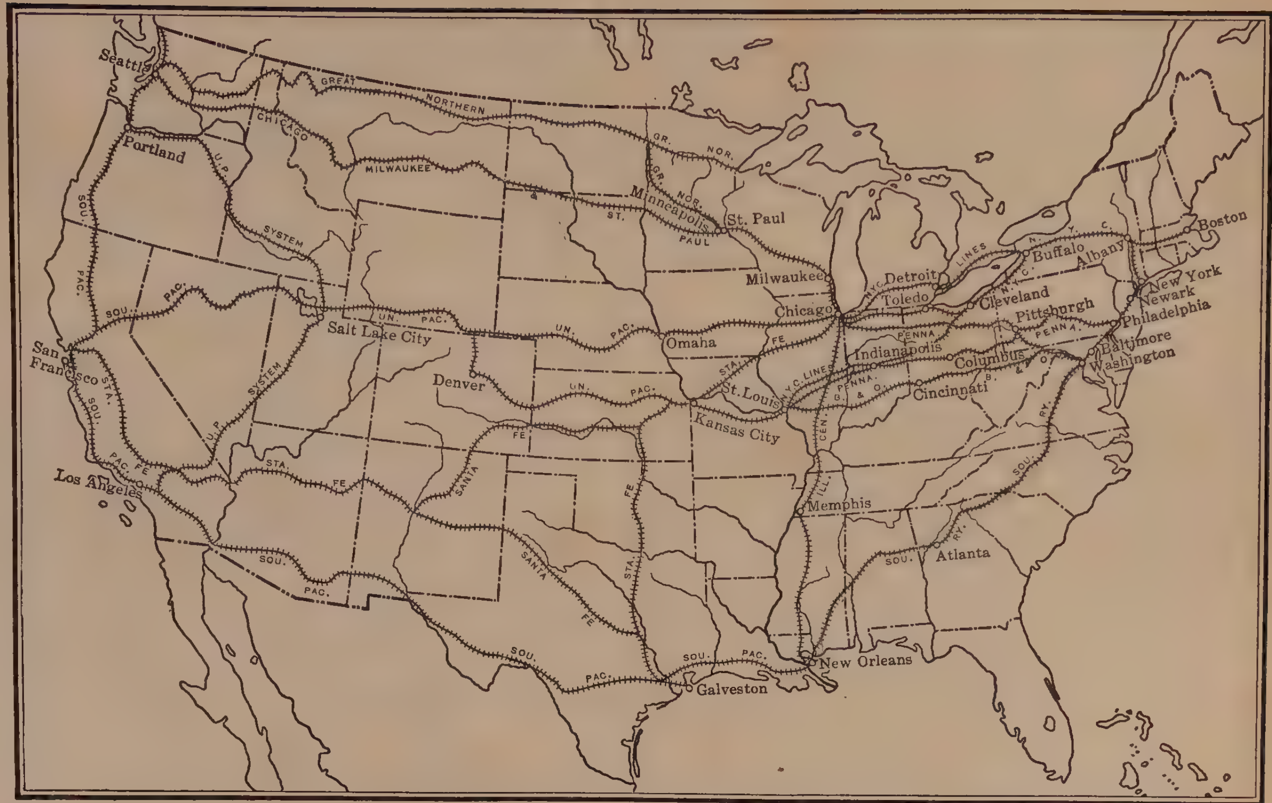


FIG. 166. Principal railroad systems of the United States

shipped from San Francisco to Eastern cities in a small fraction of the time required to ship them by boat around Cape Horn. The officials of the United States government also recognized the importance of having a transcontinental railroad. About the time of the war between the Northern and Southern states, two companies were authorized to build the first road. One began at the Pacific coast and worked eastward. The other began in Iowa, where the Eastern rail lines ended, and worked westward. The two railroad-construction gangs worked toward each other at top speed, surveying, fighting Indians, and laying rails. Finally, on May 10, 1869, they met, and the tracks of the two companies were joined at Promontory Point, Utah. The completion of the first transcontinental railroad was celebrated as a great event in our history. East and West were tied together.

The Result of a Century of Railroad-Building

The completion of the first transcontinental railroad marked the beginning of an era of Western railroad construction. Other great systems were built. (See figure 166.) There was the Great Northern and the Chicago, Milwaukee & St. Paul, connecting the north-central states with the state of Washington. There was

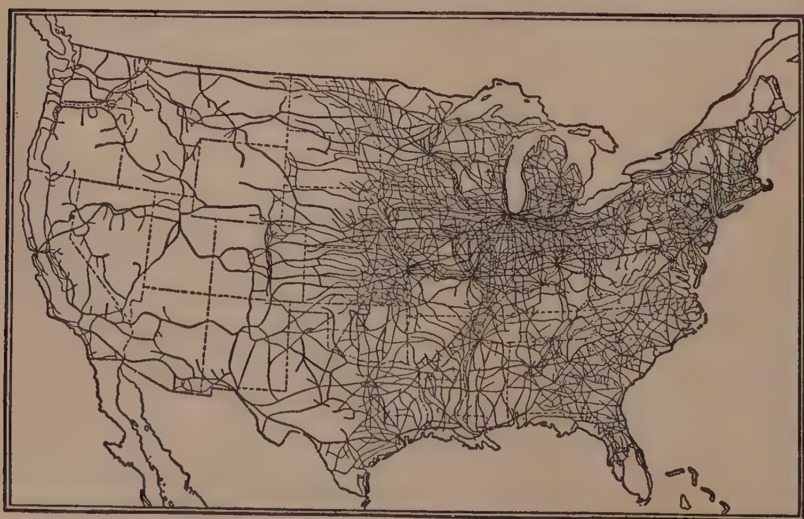


Fig. 167. The railroads of the United States today

the Santa Fe, connecting Chicago, St. Louis, and Kansas City with Los Angeles and San Francisco. There was the Southern Pacific, which joined New Orleans and Los Angeles. North and South, East and West, ran the new trunk lines. Within 50 years after the building of the first railroads several great systems tied together the most remote parts of our country. Compare the map of figure 167, which shows the entire network of railroads, with that of figure 164, which shows the railroads which had been constructed by 1830. Then compare it with figure 166, which shows where the main railroad systems run. Note that there are more miles of railroad in the northeastern part of the country than in the western or the southern parts.

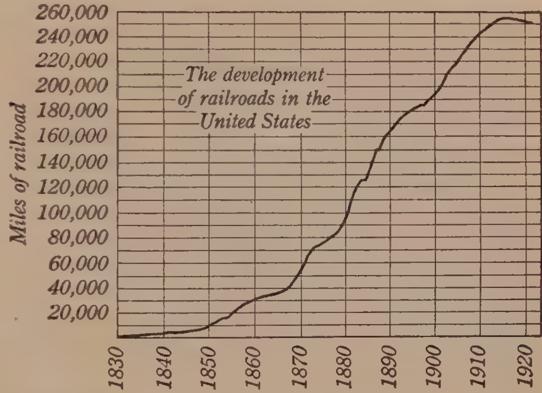


FIG. 168. The number of miles of railroad in the United States, 1830–1920

The extent of our railroads is shown not only by the maps of figures 166 and 167, but by the increase in the number of miles of track (see figure 168). In 1830 there were 23 miles of track; in 1920 there were 250,000 miles. Notice how rapidly the mileage of our railroads grew, especially after 1870. The result is a tremendous national system of railroads.

An immense sum of money has been invested in "rights of way," tracks, bridges, stations, locomotives, and cars. The estimated investment in railroad and other leading industries in the United States is as follows:

Railroads	$27,800,000,000
Oil	11,000,000,000
Iron and steel	5,000,000,000
Textiles	4,100,000,000
Automobiles	3,000,000,000
Meat	1,200,000,000
Publishing	1,200,000,000
Clothing	1,000,000,000
Construction and machinery	(Very important; but no estimates)

Today our railroads form a large part of our national wealth, just as do our mineral resources. Their "service" value, however, is far more important than their investment value. They are working for us all the time, carrying our raw materials and our goods.

The vast extent of the railroads of the United States is clearly shown when compared with that of other countries. At the present time there are approximately 750,000 miles of railroad in the world. The United States has, in round numbers, 250,000 miles. With about one twentieth of the world's area and one sixteenth of its population, the United States has one third of the world's railroads. Our railroad mileage is about equal to that of all the countries of Europe combined.

	Miles of Railroads
United States	*250,156*
Russia	45,742
Canada	40,061
India	38,270
Germany	35,416
France	26,200
Australia	24,618
United Kingdom	19,573
Japan	10,414
Belgium	5,901
Europe: Total miles of railroad, 232,621 World: Total miles of railroad, 750,000 (about)	

FIG. 169. Railroad mileage of the countries of the world which lead in the use of railroads

With the exception of Russia, which extends from eastern Europe clear across Asia, the United States is much larger than any country of Europe. It would not be accurate, therefore, to compare the railroad mileage of a large country like the United States with the mileage of a small country like Belgium. To make a true comparison, we must know how many miles of railroad a country has in comparison, for instance, with its total area. These facts are presented in figure 170.

We find that the smaller and more well-to-do countries — Belgium, the United Kingdom, Germany, and France — have built more miles of railroad in proportion to their area than has

Miles of railroad for each 1000 square miles of territory

Belgium	502
United Kingdom	208
Germany	195
France	123
United States	*83*
Japan	70
India	35
Australia	8
Russia	6

FIG. 170

the United States. Each of these countries, like the United States, does a great deal of machine-manufacturing; hence there is a great need for railroad transportation. In other countries of large area, however, in which most of the people live self-sufficient lives on their farms, fewer railroads have been built. In proportion to square miles of territory, Russia has only one fourteenth as many railroads as the United States, and only one eighty-fourth as many as Belgium.

Improvements in railroads

Not only have our railroads become vast in extent but they have greatly increased in efficiency. Modern railroad transportation means power and speed — speed for the passenger trains, great power for the freight trains. Compare the modern locomotive with the engine of the little *De Witt Clinton* train (both shown in figure 161).

How the size and power of locomotives have increased! Each time a new engine is made the designers think they have reached the practicable limit in size. In 1875 locomotives averaged about 40 tons. Today they weigh several hundred tons.

As locomotives and cars have become larger and heavier it has become necessary to make rails much stronger. These are now made of hard, durable steel, instead of brittle iron. Today the road embankment, which holds the rails firmly in place, must be made of heavy crushed rocks and rolled cinders, carefully graded, so that it will support the heavy loads. The bridges which carry our great trains safely across rivers are no longer built of wood, as were the first railroad bridges. They are strong, lasting structures

of steel and concrete. Instead of long, difficult routes over the mountains, tunnels have been cut through them — another evidence of the conquest of distance by railroad engineers.

Other improvements are being made. Many railroads near great cities have been electrified; that is, the trains are run by electric power instead of by steam. In transportation, as is also true in the case of manufacturing, electric power saves fuel and is more efficient.

What our Railroads do for us

You can readily see how important the railroad service is in making it possible to get from one place to another. But perhaps

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Fig. 171. A freight terminal. Note the various kinds of freight cars. Each kind may carry a different sort of product

you have not understood that an even greater service which the railroads perform is the carrying of food, fuel, and the thousands of articles needed by the people. The freight service of our great national system of railroads is many times larger than the passenger service. Note the startling contrast in a recent year:

Passenger, baggage, and mail cars	57,000
Freight cars	2,590,000

The amount of money received by the railroads from freight and passenger service (figure 172) also brings out the comparison strikingly. In whatever way we make the comparison, the freight business of the railroads is much greater than the passenger business.

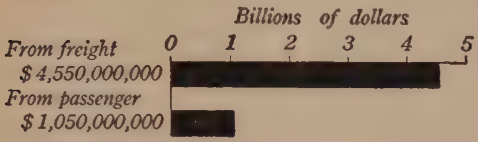

FIG. 172. Comparison of income received in a recent year from freight and passenger service

Every day, every night, every hour, long freight trains are winding through valleys and across plains, bringing us goods of all kinds: food, clothing, furniture, lumber, coal, steel, machines, farm products, and manufactured goods. Without these long lines of moving freight trains, we could not

FIG. 173. Interior of the main waiting room of the Grand Central Station, New York City. (Courtesy of the New York Central Railroad)

possibly live the kind of life we live today. It is difficult to realize what a vast exchange of goods there is between the different communities of a great industrial nation like ours. Government reports tell us that in 1925 more than 1,247,000,000 tons of freight were loaded onto cars and hauled an average distance of over 300 miles. The freight that is carried by American railroads in

one year would fill 100 trains, each 3500 miles long. This is more than the distance across the United States from coast to coast.

What might each of these 100 trains carry? Fifty-five of them would be filled with the products of mines — coal, iron ore, copper, etc.; 26 of them would contain manufactured things; nine would carry products of the farms; eight, lumber and other products of the forest; two, animals and animal products. As you watch a freight train go by, counting the cars as they pass, what do you see? Box cars, flat cars, coal cars, refrigerator cars, tank cars, live-stock cars, even special cars for milk, poultry, and other products. Can you imagine what a tremendous job it is to handle all this freight?

Summary

Even though you may seldom ride on a railroad train, the railroads are working for you every day, carrying coal to the factories which prepare your food and make the cloth for your garments, bringing gasoline for your automobiles, carrying furniture for your houses, and hauling a hundred other things to markets where you may purchase them. Today we are just as dependent upon a fine system of railroads as we are upon our national system of trade.

The growth of our railroad system is another example of the changes brought about by the Industrial Revolution. Watt's tiny engine for pumping water was the seed of an idea which helped to make possible the 250,000 miles of railroad that bind together thousands of communities throughout the United States.

INTERESTING READINGS FROM WHICH YOU CAN GET ADDITIONAL INFORMATION

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CHAPTER XVI

TRANSPORTATION ON THE WATERWAYS OF THE UNITED STATES

In the year 1788 the curiosity of Americans who lived on the banks of the Delaware River was aroused by the appearance on the river of a queer-looking craft. The boat had no sails and yet it

FIG. 174. This is the way the artist imagines the scene of the trial of the first steamboat used in the United States for regular transportation, made by John Fitch, 1788. (Courtesy of the Continental Insurance Company, New York)

moved. Even against the current of the river it attained a speed faster than a man could walk, but not without a great deal of noise, of puffing and snorting, and splashing of water. But move it certainly did, propelled by some mysterious force.

What was all this fuss about? John Fitch was experimenting with his "steamboat!" Only a few years before, James Watt had received a patent in England on his steam engine. Both in Europe

and in the United States people were trying to use it to propel boats as well as wagons. But to build engines and boats required money, and Fitch was a poor man. So for years he tried to get help from wealthy business men, from governors and legislatures. Little help was forthcoming, and almost alone he struggled to prove that boats propelled by steam were practicable.

In 1788 Fitch launched the first steamboat ever used in the United States for regular transportation. Remember that this was 40 years before the first practicable railroad. In that year his boat made a trial trip of twenty miles. Slowly he improved it and in 1790 it ran more than 1000 miles on the Delaware River at an average rate of about eight miles an hour in smooth water. In spite of this, however, the people of his day had little faith in this new kind of transportation, and in 1798 Fitch was compelled to give up the struggle.

Fitch's experiments marked the beginning of a long revolution in water transportation. From that time on the transportation of goods and people on the streams of the United States changed in much the same way that transportation did on land. We have already seen that a vast web of fine roads and railroads was built to bind together the widely separated parts of our country. At the same time a country-wide system of river and lake transportation grew up.

We can travel and transport goods by ways other than by land: by water and by air. To understand the manner in which our people are bound together, we must study all the methods of transportation. In this chapter, therefore, we shall read the story of the development of the waterways of the United States.

The Early Settlers made Use of the Rivers and Lakes in Transporting Things

From the very earliest days of American history trails and roads had to be made. To make them took time and money. One cheap way of transporting goods, however, was always at hand — the rivers. The first settlements in Virginia, Massachusetts, New York, and Pennsylvania were made on the banks of rivers and near the sea. For the first 200 years goods were transported by

water whenever possible, and by 1800 the rivers as well as the new highways were busy places. Thousands of settlers were already living up in the valleys of the Eastern mountains, and even beyond them along the Ohio River. As we have learned in the chapters on roads and railroads, these people were trading with the business men of Eastern towns and cities. So the rivers were, indeed, busy places. Hundreds of flatboats were carried along on the spring freshets made by the melting snows in the mountains. Down the

FIG. 175. An old river flatboat — a raft with a house on it. Flatboats like that shown in the picture were often seen on our rivers until after 1860

Hudson River to New York they went; down the Susquehanna and the Delaware to Philadelphia and Baltimore. Men's muscles were hardly needed in these downstream journeys.

On the eastern slope of the mountains the Monongahela and Allegheny rivers carried small craft into the Ohio at Pittsburgh. Pittsburgh was already a bustling little community. It had grown up at the junction of the rivers and was the starting point for the flatboat trip down the Ohio to the settlements of the West.

After 1800 on the Ohio and the "Massassip," as the river men called the Mississippi, appeared an astonishing variety of river boats. There were log canoes, skiffs, boats with keels and boats without them. There were large freight barges, even passenger packets, all built to float downstream, for they were too heavy

and unwieldy to be propelled easily up the rivers. Long sweeps or oars at the ends and sides guided them. By thousands they drifted down the Ohio. Most of them were flatboats like that shown in figure 175. Curious things they were — log-cabin forts, floating barnyard, and country grocery all on one craft. These boats carried men, women, and children, horses, dogs, dishes, provisions, farm tools, pigs, kegs of powder — everything that the frontier civilization depended upon. Do you wonder that sometimes they were referred to as "arks"?

In this westward movement, after 1800, the settlers used another water route — the Great Lakes. Notice on the map of figure 185 the great length of the coast line of these lakes. To go through them all in the straightest possible line would mean more than 1000 miles of travel. The settlers who lived close to these Great Lakes built sailboats to transport their belongings to points along the shore where settlements had begun to appear in the early 1800's. By 1834 a trading point was established as far west as Fort Dearborn on Lake Michigan. Not long afterwards the city of Chicago grew around this fort.

Robert Fulton and his Steamboat, the *Clermont*, really started the New Era in Steamboat Transportation

Keeping pace with the westward building of trails and roads, therefore, the use of the rivers and lakes developed. The downward current of the Ohio, the Mississippi, and the other Western rivers provided free power for boats; men's muscles were needed merely to steer. But once the destination, say New Orleans, was reached the difficulty was to return against the current of the river. Some hardy river men even rowed or poled their way back, up the Mississippi to St. Louis, up the Ohio to Cincinnati, even to Pittsburgh. Others, however, preferred to sell their boats at New Orleans for old lumber and work their way back on foot over the long wilderness trails.

In the meantime other men than John Fitch had been trying to apply steam power to boats. In Virginia on the Potomac River in 1787, James Rumsey had developed a steamboat that worked moderately well and had tried to secure help to perfect

his invention. He died, however, before the boat was really successful. In 1792 several men in Connecticut and Rhode Island were partly successful in propelling boats with engines. In 1793 Captain Samuel Morey also succeeded in propelling boats with steam, but each of these inventors was unable to secure enough power to drive large boats laden with passengers and heavy freight. Hence their experiments were not commercially profitable. In all these years John Fitch's boat was the only one that had any considerable success, and for this achievement he is remembered in the history of water transportation.

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FIG. 176. Robert Fulton, the inventor of the first commercially practicable steamboat

In the year 1786 Robert Fulton, an American youth of twenty-two, went to England to study painting. Twenty years later he returned to the United States, but not before he had become known in France and England as the inventor of the first practicable steamboat, and also of the first submarine. From art he had turned to science and carefully trained himself in the scientific knowledge of the day. Because of this knowledge he succeeded where John Fitch and others had failed. For nine years Robert Fulton had labored at his careful experiments. As a result of these he discovered how large engines and boats should be in proportion to the strength of the tide, the current of the water, and the load to be carried. In this work of Robert Fulton is illustrated again how science brings success in invention when guesswork fails.

So Robert Fulton returned to the United States with one of James Watt's engines and in August, 1807, ran his steamboat, the *Clermont*, from New York to Albany, a distance of about 160 miles, against the current of the Hudson, in 32 hours. At last the steamboat was proved to be a practicable means of river transportation.

Almost at once business men began to organize regular steamboat companies on each of the chief rivers. On the Hudson, for example, Fulton and his partner, Livingston, started one of the first companies and for years controlled almost all the steamboating on that river. Other companies obtained money and built steamboats on the Delaware, the Susquehanna, and the other rivers on the eastern slopes of the Appalachians.

Only four years elapsed between Fulton's success with the *Clermont* and the trial of his first steamboat on the Ohio. One day in October, 1811, a crowd of people gathered on the shore of the Ohio River at Pittsburgh and looked with astonishment at a little boat which lay on the water before them. It was the *New Orleans*, a steamboat owned by a representative of Fulton and Livingston, and different from anything ever seen in Pittsburgh. It had a smokestack and two masts, and, at the stern, a paddle wheel. As it moved out into the water great clouds of smoke poured out of the smokestack. The crowds on the bank cheered the new craft. Down the Ohio went the *New Orleans*, causing a great commotion at each settlement. It started a new era of river transportation in the valleys of the Ohio and the Mississippi.

From that time on steamboats multiplied and soon the little flatboats almost disappeared.

A Period of Canal-Building began shortly after 1800

The years immediately after 1800 were, indeed, years of many experiments in transportation. Roads were being built and wagons and coaches improved. Horse-drawn cars were being pulled over crude rail lines, and rumors were heard of new experiments in steam wagons and locomotives. Even steamboating had been proved to be practicable.

It appeared that the American people — both the pioneers of the West and the business men of the towns of the East — wanted cheaper and more rapid transportation more than anything else. What could be cheaper than waterways now that the steamboat had come? For 200 years Americans had lived along the rivers and the seacoast. Certainly they knew the cheapness of water transportation. They had been building fine stone roads along

the plains and in the valleys. These roads provided good transportation, it is true, but they were very expensive to make and to keep in repair. Right there, perhaps in the same valley, was the river. Now that Fulton had made the steamboat practicable, why not use water transportation instead of land transportation? It was much cheaper and just as quick. But the rivers were navigable only over short distances. The Hudson, for example, was navigable only from New York to Albany; the Delaware, the Susquehanna, the Potomac, and the other Eastern rivers, for only about 100 miles each. There were rapids and waterfalls in the rivers which large boats could not pass.

But the Americans of that day, like those of our own time, were ready for any undertaking, even that of deepening the rivers or building canals around waterfalls. Was it not to be expected, therefore, that the people living on both sides of the Appalachian Mountains and wanting to trade with each other would dare even to try to cut waterways through the mountains? They not only dared, but in the next 50 years they succeeded in building canals and deepening rivers in many parts of the United States.

Where could the canals be built to join the Eastern states with the Middle West? Turn back to the map of figure 164. It will help you to see how the builders answered that question. *First*, note the location of the Eastern cities — New York, Philadelphia, and Baltimore. *Second*, note the location of population west of the Appalachian Mountains, settled between the Ohio River and the Great Lakes (Pittsburgh, Cincinnati, and other towns were already of considerable size). *Third*, note what a barrier the Appalachians were, hemming in New York, Philadelphia, and Baltimore on the narrow seacoast plain. Were there no natural routes through the mountains which could be made easily into through waterways? Only one — the Hudson River and Mohawk valley route in New York State, joining New York City and Buffalo. The Hudson River was navigable all the way from New York City to Albany. If a canal could be built through the Mohawk valley from Albany to Buffalo, freight could be brought by boat all the way from New York City on the Atlantic Ocean to Buffalo or to any farther ports on the Great Lakes. Through such a canal the goods of the Middle West could be shipped to the Atlantic.

The building of the Erie Canal, 1817–1825

While stage wagons were rolling along the new stone roads and the steamboats of Fulton and Livingston were transporting increasing amounts of goods on the navigable river routes, New York business men tried to dig the first important canal in the United States. De Witt Clinton, governor of New York State, reminded his people of the opportunities the Mohawk valley offered them. He showed them that by digging a canal through it they could transport goods from Lake Erie to New York City for about one twentieth of the money which they were then paying to ship by pack horse and stage wagon. In pleading for help he said to the legislature of New York State, "Do you know that the Canadian merchants of Montreal sell their goods in our state for less than our own merchants can?" The members of the legislature were indignant, but they found that Clinton was right. The Canadians had water transportation all the way from Montreal!

FIG. 177. This picture shows one of the early passenger boats on the Erie Canal. Notice that it is being towed by mules

Clinton and his friends studied the relief map carefully and planned a canal. They took advantage of the fact that the Mohawk valley slopes gradually from Lake Erie to Albany. In spite of the jeers of the skeptics they started a company in 1817, and in eight years the workmen succeeded in digging a great ditch 365 miles long and 40 feet wide, with water four feet deep, thus connecting Lake Erie with the Hudson River at Albany. While the work was going on, scoffers named it "Clinton's Ditch," but in 1825 De Witt Clinton himself was able to ride in the first boat to go from Buffalo through the Erie Canal down the Hudson

River to the Atlantic Ocean at New York. There, to celebrate the opening of the first great canal in the United States, he emptied into the Atlantic Ocean two kegs of water which he had brought from Lake Erie. Thus the opening of the Erie Canal joined the Great Lakes and the Atlantic Ocean for the first time. The jeers of the unbelievers changed to cheers as they discovered that a ton of western New York State produce could now be shipped to New York City for $1; the same ton transported by wagon had cost $32.

Then Philadelphia and Baltimore Business Men also tried to build Canals through the Appalachians

With the opening of the Erie Canal much of the Western freight was shipped to the Eastern seaboard through this canal. This increased the trade of New York City. The business men of Philadelphia, finding that New York was taking away their trade with the Middle West, also tried to build canals through the mountains. How unusual an engineering achievement they accomplished you will understand if you look at the relief map of figure 164. On the line between Philadelphia and Pittsburgh the mountains rise to a height of more than 2500 feet above the sea level. (Remember that at no point in the Mohawk valley is the land through which the Erie Canal passes more than 500 feet above sea level.) Nevertheless, so great was the desire for trade with the West that the Philadelphians tried to dig a canal through these mountains. Along the gradual slope of the Schuylkill River went their canal to Reading. From this point to Hollidaysburg, Pennsylvania, the route paralleled the Susquehanna and Juniata rivers as far as the mountains would permit. At Hollidaysburg the canal was 1000 feet above sea level. How to extend it through the mountains from Hollidaysburg to Johnstown was the great problem. The distance was only 36 miles, but a mountain wall 2291 feet high intervened. The problem was solved, however, by building a cable railroad over the mountain. On this railroad the cars were pulled to the summit of the mountain by a cable which was attached to a stationary steam engine. Then the cars coasted

down the other side of the mountain. Sometimes even the canal boats were dragged out of the water, mounted on the cars, and pulled over the summit of the hill.

Finally, in the autumn of 1834, the stanch boat *Hit-or-Miss* made the first journey along the whole length of the canal. "It rested for a night on Allegheny's summit like Noah's Ark upon Mount Ararat and descended next morning into the valley of the Monongahela River" and was carried by the swift current of this stream to Pittsburgh.

This was an expensive way to ship goods, since it involved not only towing the canal boats by horses or oxen but also pulling them up over the mountains. For several years the people who lived on the route from Philadelphia to Pittsburgh used the canal, although traffic through it was never very great. Indeed, the Erie Canal, although a much longer route, was much more profitable. Moreover, railroads began to be built through all the valleys. Gradually shippers began using the railroads and stopped using the Philadelphia Canal. Soon the owners found that they were losing money, and finally they had to abandon the canal route altogether.

FIG. 178. The heavy lines show the extent of canal construction in 1850. Note that by that time canals had been built from the Atlantic Ocean as far west as Illinois. Most of these canals connected the larger rivers and the Great Lakes

The business men of Baltimore also wanted to secure their share of the trade with the Middle West. They saw that if they were to trade with people on the other side of the mountains they too must have rapid and cheap transportation. If Baltimore was to become an important ocean port, some way must be found to bring Western produce to their city. So without waiting to see what would be the success of the Philadelphians they too tried to dig a canal

through the mountains. But the obstacles before their engineers were even greater than those which the Philadelphia men had encountered. Although they struggled with the problem for several years they never succeeded in joining the Ohio River with Baltimore by means of a commercially practicable canal. Soon, however, they were glad enough to give up the attempt, for the Baltimore & Ohio Railroad had been built through the same region. Started in 1828, track was laid during the next few years, joining Baltimore with the surrounding country. In the 1830's the railroad was built through the river valleys and over the mountains to the region of the Ohio.

The New Cities of the Ohio Valley also built Canals

Between 1825 and 1850 canals were built in many places, joining the rivers of the Middle West with the Great Lakes. After 1825 the region between the Ohio River and the Great Lakes filled up rapidly with new settlers. Millions of acres of land were put under cultivation. Factories were being built in towns; iron and coal mines were being worked. People were moving west, and cities were growing. There was a great increase in the amount of freight to be carried from state to state. The whole central part of our country became a busy agricultural and industrial region. So rapidly did this happen that railroads, roads, and waterways could not be improved and extended rapidly enough to take care of the traffic.

People desiring cheap water transportation dug canals connecting the rivers with each other and with the Great Lakes. Figure 178 shows that by 1850 canals had been constructed even as far west as Illinois. No sooner did Chicago, for example, begin to grow into a city than it dug a canal to connect the Great Lakes with the Illinois River. On this, small boats were able to go from Lake Michigan down the Illinois River to the Mississippi and so on down to New Orleans and the Gulf of Mexico. Lake Erie and the Ohio River were also connected by means of canals.

The Development of a Great System of Waterways: the Mississippi and its Branches

Two great waterways were given our pioneer forefathers: the Mississippi with its branches and the Great Lakes. Each has become a valuable part of our national transportation system.

Figure 179 reminds us that the rivers which drain the region between the Rockies and the Appalachians form a tremendous natural highway. Some of them — for example, the Mississippi, the Ohio, and the Missouri — are navigable for long distances. The length of these rivers is given in the following table:

LENGTH OF THE MISSISSIPPI AND ITS MOST IMPORTANT TRIBUTARIES

	Miles		Miles
Mississippi	2,466	Cimarron	650
Missouri	2,945	Cumberland	650
Arkansas	2,000	Wabash	550
Platte	1,260	Washita	550
Red	1,200	Big Horn	500
Tennessee	1,200	Cheyenne	500
Yellowstone	1,100	Minnesota	475
Ohio	950	Osage	460
Canadian	900	St. Francis	460
White	800	Total	19,616

No other continent has such a river system as that of the Mississippi system of central United States — 20,000 miles of rivers draining an area of 1,250,000 square miles and pouring their waters through one outlet into the Gulf of Mexico. The Mississippi, with the Missouri, its main branch, is the longest river in the world. But it is not only the length of the system that makes it important. It is made important also by the productive farm land and the region of manufacturing cities through which the rivers flow. The system connects every part of the great central plain between the Rockies and the Appalachian Mountains. No single large region is unsupplied with rivers of considerable size. The Mississippi system joins the fertile central plains with their rich farms and growing industrial cities to the port of New Orleans. Living along the banks of the Mississippi and its main branches is a town and city population of over

7,000,000 people. Many of these communities grew up when the river was the only means of transportation.

Up to 1860 river traffic increased steadily. Cotton, grain, hides, ores, and the many farm products of the region found their way down the streams to New Orleans. That Southern port grew rapidly, and Eastern cities looked enviously at this Western trade in which they had little share. Then at the middle of the century came the east-west railroads connecting the Atlantic coastal plain

FIG. 179. This relief map shows the Mississippi River Basin. The Mississippi River, with its tributaries, forms a natural transportation system, nearly 20,000 miles long, for an area of 1,250,000 square miles

with the rich heart of the continent — the central states. Railroads had advantages over river steamboats in that they went more directly to the Eastern cities and were not affected by seasons. So railroads took much of the carrying of freight — both that going to Eastern cities and that going to foreign ports — away from the river boats. But the rivers were still the *cheapest* way to ship the freight that was not perishable and which, therefore, did not require rapid transportation.

So even after 1870 coal barges, and freight steamers laden with cotton, grain, and other raw materials, as well as manufactured goods, continued to ply the Ohio, the Mississippi, and even some of the smaller rivers. The national government helped by main-

taining a barge line between St. Louis and New Orleans, which carried freight at 80 per cent of the rate charged by the railroads. It also aided the states bordering on the rivers in dredging and repairing them.

One of the chief difficulties in the way of using the Mississippi River is that caused by the flooding of the low plains through which the river flows. The map of figure 179 shows that most of the Mississippi River system meanders here and there through a fairly level plain. Through most of the territory drained by these rivers the land is only a few hundred feet above sea level. Furthermore, throughout much of their course, the banks of the rivers are low and have had to be raised by the construction of dikes and levees — high embankments of earth and masonry. This is necessary to prevent the great flood of water which pours down the rivers in the spring and after prolonged rains from overflowing its banks and destroying property close by. Already this has happened many times. A particularly serious flood occurred in 1927, when the rivers broke through the levees in many places, covering houses and farms for many square miles on each side of the river. As a result of the recurrence of such floods government engineers are aiding the states and communities in strengthening the river banks more substantially.

The Region along the Great Lakes grew into the Chief Industrial Section of the United States

The story of how the section between the Ohio River and the Great Lakes became the great industrial region of the United States is a thrilling one. In this chapter, however, there is space merely to remind you of the rapid growth of this important region and the tremendous increase in traffic on the Great Lakes and waterways. You have already learned that rich iron deposits were discovered in Minnesota about 1860 and that oil was found in Pennsylvania about the same time. The towns around the Great Lakes — Cleveland, Detroit, Chicago, Milwaukee, for example — were growing into large manufacturing and trading cities. Railroads were being built, manufacturing was increasing rapidly, and steel mills were springing up in Pennsylvania, in

Ohio, in Indiana, and in Illinois. Thousands of farms were being cultivated in the states bordering on the Great Lakes — Ohio, Indiana, Michigan, Wisconsin, and Illinois. In the 60 years after the close of the Civil War this region, together with the New England states, became the chief industrial section of our country. The shaded area of figure 180 marks this section. In it today are more than 90 per cent of our large cities and 72 per cent of our manufacturing. More than half of the wealth of the country is there and nearly half of the American people live there. You will learn later of the manner in which manufacturing industries grew up in other parts of the country, as in the Far West and at scattered points in the Southwest and Southeast.

In this vast region south of the Great Lakes three kinds of bulky freight were being produced in tremendous quantities — iron ore, coal, and grain. How could these be shipped to distant parts of the United States so that the cost of transportation should not be too high? Certainly not by wagon. Even by the new railroads transportation was very costly. The answer was found in the great natural highways of the Middle West — the Great Lakes.

Today the Great Lakes have become the Busiest Inland Waterways in the World

On the maps of figures 179 and 180 the Great Lakes stand out as a long inland waterway. They make a natural highway about 1200 miles long, deep enough to permit the use of steamships as large as those used in ocean transportation. They connect the two chief regions of our country — the great agricultural and mining areas of the West and the industrial zone with its cities and factories.

When people first went to live in the Great Lakes region they found natural obstructions between some of the lakes. One of these was a waterfall between Lake Superior and Lake Huron (figure 181) where the land narrows and the water becomes very shallow and rough. There were also rapids between Lake Superior and Lake Huron which made it impossible for large boats to sail from one to the other. To permit continuous water transpor-

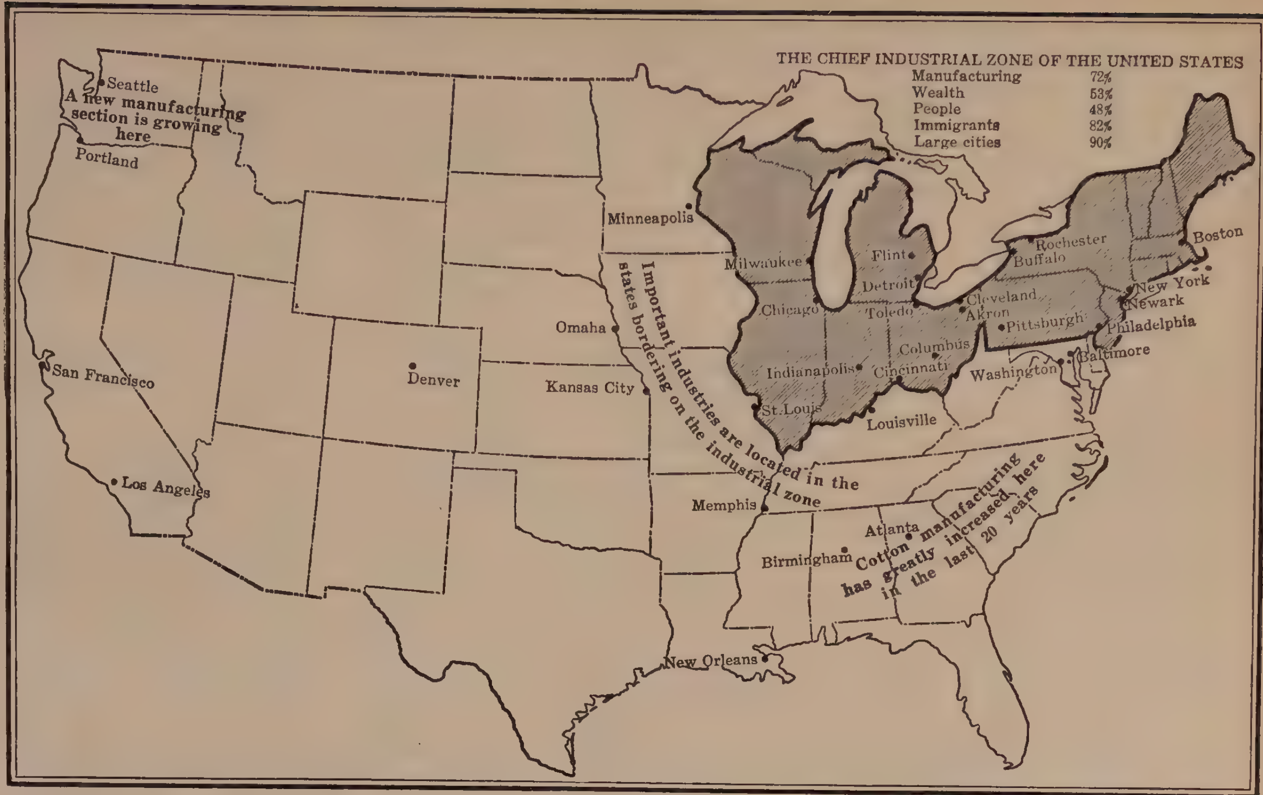

FIG. 180. The shaded area indicates the chief industrial section of the United States, one of the mightiest regions of trade in the world

tation through the lakes, therefore, people constructed a canal, named the Sault Sainte Marie (nicknamed the "Soo"). During the eight warm months in which the Great Lakes are navigable many thousands of ships pass through this canal each year. In a recent year transportation through the Soo Canal exceeded 90,000,000 tons. The importance of this waterway and the canal which joins the two lakes can be understood when we note that that amount of freight is nearly twice the combined tonnage handled by the other two great canals of the world — the Panama and the Suez — in a full twelve-month year.

Other canals have been built at additional points on the Great Lakes — for example, the Welland Canal, joining Lake Erie and Lake Ontario.

On the Great Lakes today, therefore, many thousands of ships carry iron ore, coal, grain, stone, and other bulky products. So great has the commerce on these lakes become that in a recent year it totaled 200,000,000 tons of freight — nearly half of the entire water-borne commerce of the United States. Furthermore, most of this great commerce deals with three commodities — iron ore, coal, and grain.

Iron ore and coal traffic on the Great Lakes

You have already learned that the richest iron mines in the world are located near the western end of Lake Superior. In a recent year 60,000,000 tons of iron ore were shipped from these mines.

Figure 181 shows that important shipments of iron were delivered to the steel mills of five states — those near Chicago, Gary, Detroit, Cleveland, and Pittsburgh. Most of it went to the great steel-manufacturing district in western Pennsylvania and eastern Ohio. The iron and steel mills are located in those regions for several reasons, but chiefly because coal is obtained there. You have already learned that to refine one ton of iron ore into steel ingots requires between two and three tons of coal. This means that it is much cheaper to ship the iron to the coal than to send coal to the iron mines.

A tremendous traffic in iron ore has developed on the Great Lakes

Special ships have been constructed, some of which can carry as much as 12,000 tons of ore. Any one of the largest boats carries as much iron ore as 400 railroad cars can hold. Nevertheless, such boats can be loaded in less than half an hour. Giant cranes 500 feet long are used in loading and unloading iron ore. (See

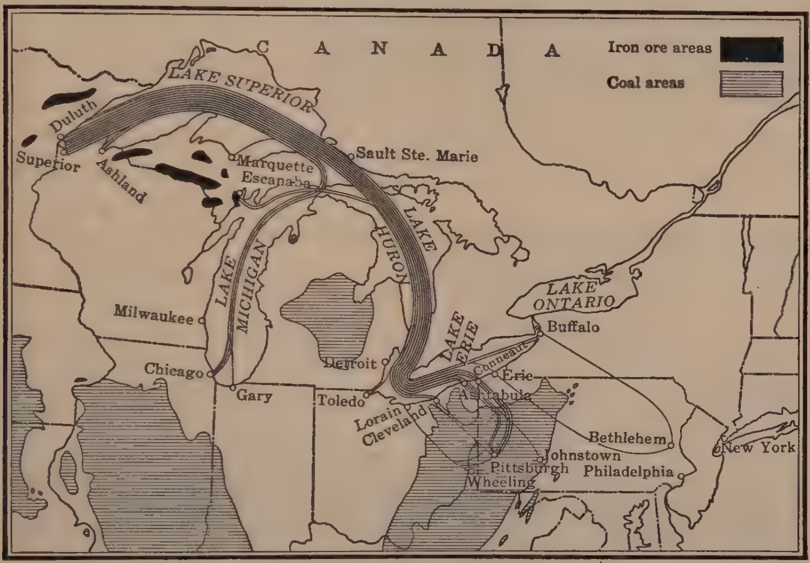

FIG. 181. The lines through the Great Lakes show the route by which ore is shipped to the steel mills of Pennsylvania, Ohio, Indiana, Michigan, and Illinois. On the return trip the boats carry coal to the people of the Northwest

figure 182.) These steel cranes lift railroad cars holding 30 tons of ore and turn them upside down, thus pouring the contents into the great hulls of the ore boats. The record for loading an ore boat is sixteen and a half minutes. When these boats arrive at their destinations they are unloaded by similar machinery.

The cost of shipping by boat is less than half the cost of shipping by railroad. The great difference is due chiefly to two factors: a boat requires much less fuel than a railroad train; little human labor is required to handle these great boats. Because so little human labor is needed, *a ton of iron ore can be carried 1000 miles on the Great Lakes for 50 cents.* A ton of coal

can be transported from Cleveland to Duluth more cheaply than it can be shoveled from the sidewalk into the cellar after it is delivered in Duluth. Is it any wonder that water transportation is considered a cheap method of shipping heavy, bulky freight?

FIG. 182. One of the great cranes used in emptying iron ore from railroad cars onto waiting vessels. (Courtesy of the Bethlehem Steel Company)

So it is that the iron ore of Minnesota is sent very cheaply by water to the manufacturing cities of the industrial zone. If these boats are to make money for their owners they must have freight to carry on their return trips. If the boats are compelled

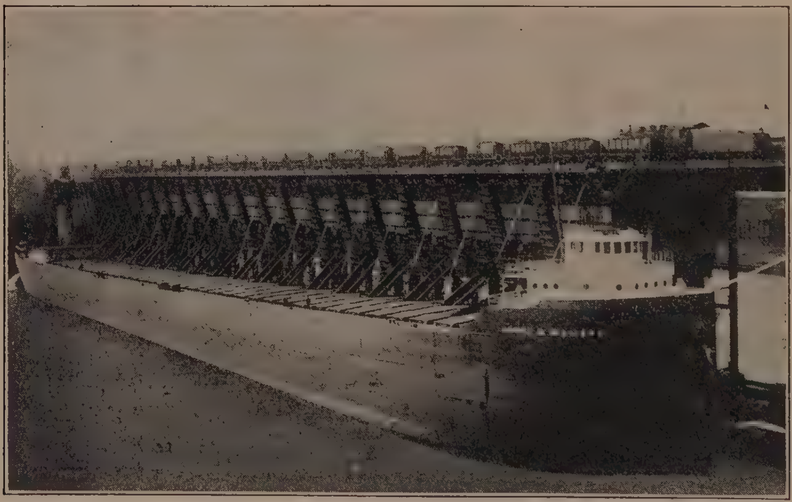

FIG. 183. Here is one of a fleet of ore boats. Note how the ore is dumped from the railroad cars above into long chutes which are connected with the bins in the boat. Almost no human labor is used in these gigantic operations. (Courtesy of the United States Steel Corporation)

to return empty from the Lake Erie ports, the cost of transportation to these ports will be greatly increased. But as we have already learned some of the Eastern states, especially Pennsylvania

and West Virginia, have large supplies of coal which are needed in the towns and cities of Michigan, Wisconsin, Minnesota, and other Middle Western states. This is the reason why many of the lake ore steamers carry coal on their return trips. In a recent year 33,000,000 tons of coal were carried on the return trips of these lake freighters.

Vast quantities of grain are also shipped east on the Great Lakes

The Great Lakes reach westward almost to the heart of the grain-producing region of the West, and eastward almost to the great ports and centers of population. It is natural, therefore, that lake steamers should also carry eastward millions of tons of grain. In a recent year east-bound lake steamers transported 12,000,000 tons of grain, mostly wheat. The grain fields of North America lie in the central part of the continent, reaching from the plains of Oklahoma and Kansas to the plains of Canada. On these plains are raised each year millions of bushels of wheat, corn, barley, and oats to provide food for the people of the United States — indeed, for many people who live in other parts of the world.

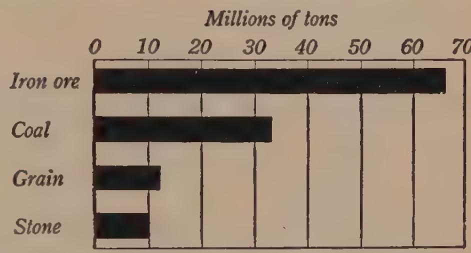

FIG. 184. This graph shows the huge amounts of iron ore, coal, grain, and stone which are shipped annually through the Great Lakes

The United States has no greater transportation problem than getting the grain from the prairies to the flour-manufacturing centers and from these centers to the homes of the people. The combined port of Duluth and Superior (see figure 181) is the greatest grain-shipping port on the lakes as well as the greatest port for the shipment of iron ore. The grain steamers are loaded and unloaded by machinery in the same economical way as are iron-ore boats. The Great Lakes make possible an inexpensive means of shipping grain. As has already been said, transportation by water is much cheaper than transportation by land. For example, in 1926, to ship a bushel of wheat from Chicago to New York by

lake and canal cost about eight cents, while by rail the cost was about eighteen cents. Thus the freight rate by water was less than one half that by rail. By the Great Lakes, nature has furnished the cheapest method of transportation for the central part of the continent.

Three Different Plans to connect the Great Lakes with the Ocean

The examples which we have studied illustrate the importance of the Great Lakes as a vast natural pathway between the West and the East. Although nature has been kind to our people in providing them with an excellent inland waterway, she has not supplied them with a convenient outlet from this waterway to the ocean; long and deep as the Great Lakes are, they are "land-locked" except for the St. Lawrence River outlet. Notice on the map of figure 185 how they stretch from the western end of Lake Superior to the eastern end of Lake Ontario. There they stop. By the St. Lawrence River route they are about 1000 miles from the sea. Moreover the St. Lawrence contains impassable rapids and is blocked three or four months in each year by ice. Even by the shortest all-water route — the Erie Barge Canal and Hudson River route — it is about 500 miles from Buffalo, on Lake Erie, to New York City, on the ocean. Furthermore, although the system of Great Lakes reaches from the northern shore of Lake Superior to the southernmost shore of Lake Michigan near Chicago, still from Chicago to the Gulf of Mexico an all-water route even if made serviceable would be more than 1000 miles in length.

The Great Lakes, therefore, do not reach all the way to the Atlantic and have no navigable rivers proceeding from them directly to the sea. This has been a serious handicap for a long time, for many things are exported from the Middle Western states to other countries. This means that goods shipped from Duluth, Chicago, and Cleveland cannot be loaded immediately onto the great seagoing ships which will carry their wares to Liverpool or London, to Bordeaux or Hamburg, to Singapore or Yokohama. In order to get the goods out of the central part of the United States to some Eastern port where they can be shipped

on an ocean vessel, they have to be unloaded and reloaded at intervening ports like Buffalo. There the goods must be transferred to barges for transportation on the Erie Barge Canal, or to railroad cars to be carried to New York, Baltimore, Philadelphia, or Boston. At the seaport they must be reloaded onto seagoing ships. This unloading and reloading of goods is very costly in time and money.

Three ways of making an all-water route suitable for ocean-going vessels from the Great Lakes to the sea have been proposed:

1. The St. Lawrence River route.
2. The Erie Barge Canal and Hudson River route.
3. The route of the Illinois Ship Canal and the Mississippi River to the Gulf of Mexico.

The first route: the St. Lawrence River

The relief map in figure 185 shows the three possible water routes from the Great Lakes to the Atlantic Ocean. Of these the St. Lawrence route appears to be the cheapest one to develop. Trace this route on the map of figure 185. The water of the Great Lakes flows into the Atlantic Ocean by way of the St. Lawrence River. However, ships cannot sail straight through, because there are several rapids and falls. The most important of these is Niagara Falls. At this point the water of Lake Erie flows through the Niagara River over the great falls and through rapids into Lake Ontario. The waters of Lake Ontario are 326 feet lower than those of Lake Erie. Some years ago the Canadian government overcame this obstacle for *small* ships by building the Welland Canal between these two lakes. Small ships can now be raised or lowered in several "locks," so that they can move back and forth between Lake Erie and Lake Ontario.

But there are other obstacles to transportation. Throughout much of its length the St. Lawrence River is not deep enough for the hulls of ocean-going ships. It also contains many rapids. Ocean-going vessels can now sail up the St. Lawrence only as far as Montreal.

Business men have proposed that the governments of the United States and Canada join hands to make the St. Lawrence

River navigable for ocean-going ships throughout its entire length. This would mean dredging the river and constructing larger canals and locks around the rapids. Experts have estimated that it would cost $300,000,000. During the last few years the two governments have employed a group of men to study the project

FIG. 185. This region between the Rockies and the Appalachian Mountains is the agricultural and industrial heart of the United States. For nearly a century people have tried to find a way to ship the freight of the inland part of this region to the Atlantic Ocean by means of waterways. Note the three routes that have been considered: (1) the St. Lawrence River route; (2) the Erie Barge Canal and Hudson River route; (3) the Mississippi River route

and to draw up plans for it. If such a plan is ever carried out the cities in Minnesota, Wisconsin, Illinois, Ohio, and Michigan will become in reality "ocean ports." From them ships will sail to all parts of the world with goods that will not have to be unloaded until they reach their destination, perhaps thousands of miles away. This will result in a great saving in the cost of shipping the produce of our Western cities.

The second route: the Erie Barge Canal and Hudson River

The second proposed all-water route from the Great Lakes to the Atlantic is that through the Erie Barge Canal and the Hudson River. From De Witt Clinton's time to the present day people who live in New York State and vicinity have dreamed that the Erie Canal could be made wide enough and deep enough for ocean-going steamships. As traffic on it has grown since its opening in 1825, the canal has been widened and deepened several times.

When it was first built, only little boats could pass through it — boats that would carry no more than 30 tons of freight. A great traffic with these little boats grew up, however, and until about 1850 the canal was one of the busiest inland waterways of the world. By that time the railroads, especially the New York Central and Pennsylvania systems, provided such rapid transportation that they took away much of the canal traffic. In 1862, therefore, its water depth was increased to seven feet so that boats of 240 tons capacity could pass through it. Many shippers of bulky and nonperishable goods continued to use the canal, although the railroads took most of the freight. Again, in 1903, it was enlarged and combined with other canals in the neighborhood to form a system known as the Erie Barge Canal. When finally completed in 1918 it made a continuous system of waterways 800 miles in length. The depth of the channel is now 12 feet and the width 75 feet. Through it many barges now pass each year. Because one of the chief commodities carried is grain, a large grain elevator has been built at the terminus in New York City to receive and store it.

These successive enlargements of the canal have merely served to convince many people that it can be made still larger and that some day, perhaps in the near future, great ocean-going vessels will pass from Lake Erie through the canal down the Hudson River and out into the Atlantic. Then the wish of shippers in the Middle West for ocean connections will be realized.

The third route: from the Great Lakes to the Gulf of Mexico by the Mississippi River

There is a third possible way to join the Great Lakes to the outside world with ocean-going ships. This is to dig a great canal from Chicago on Lake Michigan to the Illinois River and to widen the river throughout its entire length until it joins the Mississippi; then to dredge the Mississippi to New Orleans. This would permit ocean-going ships to pass from the Great Lakes into the Gulf of Mexico and the Atlantic Ocean.

At the present time the river is so shallow that most ocean-going vessels can go up the Mississippi only as far as New Orleans, 112 miles from the actual river mouth. From New Orleans up the river to St. Louis is 1100 miles. Throughout this distance only shallow boats can pass. At certain seasons of the year the river is not over six feet deep. If the river is to be made deep enough for ocean-going vessels it will have to be dredged to a depth of 27 feet. If this were possible, about half of all the ocean-going cargo now leaving the port of New Orleans could be shipped down the river and directly to Europe, South America, or the Far East without being unloaded and reloaded at New Orleans. Although this plan would mean very great expense, there has been much discussion of it during the past 25 years. Many manufacturers, farmers, and merchants throughout the Mississippi Valley, seeing its great commercial advantages, have united in attempting to persuade national and state government officials to carry out the plan.

Coastwise Commerce of the United States

The United States is fortunate in another respect. If the Great Lakes and all the little irregularities and islands are included, the shore line of the United States totals 60,000 miles. Along this shore line a stupendous water-borne commerce has grown up. It started along the Atlantic seaboard in the days of the first colonial settlements. For some time, indeed, it was the chief means of communication and trade between the colonies. Sailing ships carried tobacco and cotton from the Southern colonies to New

England and New York, and whale oil and other products from the Northern colonies to Charleston and other ports in the South. Up and down the coast many people earned their livelihood in transporting the goods used in trade. This commerce grew from year to year. One enterprising New Englander invented a ship called a "schooner," — a rather broad, two-masted vessel particularly well adapted for the coastwise trade. It was so shallow that it could pass in and out of the small, undredged harbors, rivers, and bays.

Along this great coast line our country has been fortunate in another respect—namely, in the many well-protected places where harbors could be constructed. New York is perhaps the best known of these harbors (see Chapter XXII). It rivals the great European ports in amount of freight handled. The list of the other outstanding ports of the United States, however, contains some surprises. Who would have expected that the second in importance, in amount of freight shipped annually, would be Duluth, an inland city on Lake Superior? Or that Los Angeles would be third; Buffalo, fourth; Philadelphia, fifth; Norfolk, Virginia, sixth; Boston, seventh; New Orleans, eighth; and Toledo, Ohio, ninth? Three of the nine ports through which the most water-borne trade was shipped in a recent year were ports on the Great Lakes — Duluth, Buffalo, and Toledo. Note, furthermore, that only one of these nine ports is on the Western coast. The Pacific coast has fewer good harbors than has the Atlantic. Most of its shipping centers in Los Angeles, San Francisco, and Seattle.

The opening of the Panama Canal (1914) has increased coast-to-coast trade

For many years after the establishment of the first colonies the shortest water route from the Atlantic-coast cities to the Pacific coast was by way of Cape Horn at the southern extremity of South America. The route was very long and dangerous. To go from New York to San Francisco ships had to cover 15,000 miles.

In 1914 the opening of the Panama Canal, which had been under construction since 1904, reduced the trip to 5200 miles.

Again modern science and engineering aided man to surmount natural difficulties. Figure 186 shows the Isthmus of Panama, a narrow strip of land approximately 50 miles wide joining Central America and South America. From its first discovery in the 1500's Europeans had appreciated the commercial value of cutting a canal through it. Before 1890 French engineers had actually began work on such a canal. It was not until 1904, in the administration of President Theodore Roosevelt, however, that the United States secured control of the land and began to dig the canal which was completed ten years later. The American engineers planned a canal to join two natural bays, one on the Atlantic coast and one on the Pacific, with a small inland lake. A great artificial lake, Gatun Lake, was constructed, and a canal was dug through the hills to the two oceans. It was one of the most important feats of engineering construction in the history of the modern world. General G. W. Goethals was largely responsible for the success of the project. In addition to the difficulties which were confronted in digging the waterway, there were the serious difficulties imposed by the climate. When work was begun, the Canal Zone was a very unhealthful place and many workmen died.

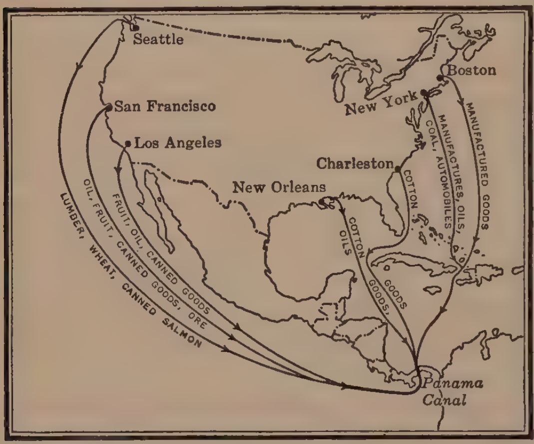

FIG. 186. The Panama Canal, opened in 1914, joins the Atlantic and Pacific ports of the United States

At last, as a result of engineering and medical skill, and the use of great power-driven machinery, the canal was completed. A continuous waterway joined the Pacific with the Atlantic. Today between 4000 and 5000 ships pass through it each year (see figure 186), carrying to the Eastern cities fruit, oil, and canned goods from Los Angeles, and lumber, wheat, and canned fish from

Seattle. Returning, some of the same ships carry cotton and cotton goods, manufactured goods, coal, etc. from Eastern ports to the west coast. In a recent year more than 7,000,000 tons of products were shipped from the west coast to the east coast by means of the Panama Canal, and more than 2,000,000 tons went back from east to west.

Summarizing our Study of Water Transportation in the United States

In this chapter, therefore, we have learned eight important facts about water transportation:

First. The United States has a vast system of waterways — a long seacoast with many fine harbors, an unrivaled connected system of rivers and lakes, and a few canals of importance.

Second. The Great Lakes and the Mississippi River system are our most important inland waterways. They lie in the most productive regions — the central farming plains and the industrial zone.

Third. The Industrial Revolution aided transportation on the Great Lakes, on the rivers, and along the coast, as it did transportation on roads and railroads.

Fourth. The Great Lakes carry more freight than any other single inland waterway. Lake steamers rival ocean-going vessels.

Fifth. Three plans are being considered for connecting the Great Lakes with the sea by means of a direct route for ocean vessels.

Sixth. Throughout the history of the country it has cost less to ship goods by waterways than by roads or railroads.

Seventh. Slowly the waterways of the United States are being improved and made navigable.

Eighth. The Panama Canal, constructed and controlled by the United States, has given us a much shorter route between the east and the west coast of the United States than we ever had before.

INTERESTING READINGS FROM WHICH YOU CAN GET ADDITIONAL INFORMATION

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"Moving the Corn Belt to the Sea — What the St. Lawrence Shipway will do for the West," *World's Work*, January, 1928, pp. 308–317.

"The Willard Ship Canal," *Scientific American*, July, 1926, pp. 32–33.

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CHAPTER XVII

AIR TRANSPORTATION

Near the end of a long day of hauling supplies by dog sled from their ship to their winter camp, the men of the Byrd Antarctic Expedition were startled by the sound of an airplane overhead. Swiftly out of the distance it came, and Commander Byrd waved to his men as he passed over them. Sverre Strom, the giant Norwegian mate, looked first at the plane disappearing over the horizon and then at his tired dogs and shook his head. At the ship later that night he said to Byrd: "I stopped the dogs and watched you fly by, and then I said to myself, 'Here I am a thousand years behind the times.' Ja, a thousand years — sweating and pulling and doing in three hours what you do in ten minutes. It made me feel old like an Eskimo."[1]

What a contrast in travel! Man and his slow-moving, weak animals, the first means of transportation, struggling with the difficulties of land travel; the swift and high-powered airplane, his latest achievement, flying unhampered through the air.

Today speed of travel by highway and railroad has been left behind by the swifter travel by air — from New York to Paris in $33\frac{1}{2}$ hours, across the United States in 21 hours. No ship can cross the ocean so rapidly, and no train or automobile can equal this record in crossing the continent. Within the lifetime of grown people the airplane has been added to the automobile, the railroad, and the steamship as another great tie that binds people together.

Men have always dreamed of Flying

Stories that have come down to us from ancient times show that people always speculated about flying. There was, for example, the old tale of the man who tried to fly by fastening

[1] *New York Times*, January 18, 1929.

feather wings to his body with wax. Unfortunately the man flew too near the sun, the heat melted the wax, and he and his feathers tumbled to the earth.

There was a medieval physician to a Scottish king who also tried to fly with feathers. He chose eagle wings because the eagle, of all the birds of flight, soars the highest. But when he donned his suit of feathers and jumped from the castle walls, instead of mounting like the eagle he fell to the ground and broke his "thee-bone." In spite of the accident he still had faith in wings and had a ready explanation for his fall. Chicken feathers, he said, must have been mixed with those of the eagle; and it is well known that the chicken prefers the earth to the air. So he argued that these feathers had brought about his fall.

Besides the myths about flying, early scholars spoke and wrote about how it could be done. For example, Leonardo da Vinci (1452–1519), the famous Italian scientist and artist, wrote about flying. To illustrate his theories he even drew plans and made models of flying machines. A century later Francis Bacon, a renowned English thinker, stated his belief that men would conquer the air.

So through the centuries men dreamed and theorized about flying. But so far as we know no one actually flew, even a very short distance, until people learned more scientific ways of doing things. In the 1700's, at the very moment when Watt and Hargreaves and others were inventing engines and machines, people were experimenting with aircraft that would lift them from the ground and carry them through the air.

1. The Invention of Lighter-than-Air Ships

The first step: fire balloons

In 1783 two brothers by the name of Montgolfier, Joseph and Étienne, sons of a French paper-maker, were experimenting with balloons. The movement of floating clouds had suggested to them that a bag could also be made to float if it could be filled with something as light as air. The clouds suggested smoke; so they took some of their father's paper and made a large bag

with an opening at the bottom under which they built a little fire with straw. As the smoke rose it filled the bag and actually lifted it. This excited the brothers very much.

They then made a larger paper balloon, 110 feet around, and filled it in the same way as before with heated air. As a result of their experiments they had discovered that hot air is lighter than cold air, and that it was the heated air from their fire and not the smoke, as they had at first supposed, that lifted the balloon. At their first public exhibition the balloon rose to the unexpected height of 6000 feet, and as the air within it began to cool it gradually descended. At this success there was great excitement, and the Montgolfier brothers were encouraged to build a larger balloon that would carry passengers. To their next balloon they attached a little platform and placed on it a sheep, a rooster, and a duck. The balloon rose, gently sailed along with the wind for approximately half a mile, and then descended in a forest. The animals were uninjured with the exception of the rooster, which had been stepped on by the sheep.

Fig. 187. An artist's idea of the ascent of the first man-carrying balloon, made by the Montgolfier brothers in France, 1783. Two passengers are seen waving to the people below. (Courtesy of *Aëro Digest*, New York)

The next thing was to test the balloon with human passengers. King Louis XVI did not approve of wasting people's lives in that way, but he finally decided that some men who were in prison condemned to die should make the ascent. On hearing that, a young man, Pilâtre de Rozier, exclaimed indignantly: "What! Shall vile criminals have the first glory of rising in the air! No, no, that can never be!" So the king relented and gave Rozier

permission to make the first ascent. A rope was fastened to the balloon to keep it from sailing away. Rozier stepped onto the platform and was lifted to a height of 75 feet, the full length of the rope. Benjamin Franklin, the famous American inventor and statesman, who was in France at the time, witnessed the unusual event. Later Rozier and another man made an ascent in a free balloon, taking along with them additional fuel, which they put on the fire carried below the balloon. When they found themselves descending they put on fuel; when they rose too high they let out some of the hot air by pulling a cord which opened a hole in the bag. Thus they made a considerable journey.

The second step: gas balloons

The danger of balloons catching fire from the blazing straw led inventors to consider other things than heated air with which to fill their balloons. Hydrogen gas, which weighs only one seventh as much as air, was tried, and worked well. Bags were made of thin silk varnished over so that the gas could not escape through the cloth. The first demonstration was conducted in a rainstorm. In spite of the rain the balloon rose to a height of 3000 feet, remained in the air three quarters of an hour, and came down in a field fifteen miles away. Superstitious farmers at work in the field feared this strange object from the sky and tore it to shreds. To protect further experiments the king himself had to issue an order that things coming down out of the clouds were on no account to be touched.

Gas balloons were improved rapidly, and in 1785 the first one actually floated from England across the English Channel to France. The trip was made by a French aëronaut, Blanchard, and Dr. Jeffries, an American who eleven years before had made balloon ascents from London to study wind and weather conditions. Their balloon rose successfully with its load, but midway across the Channel it descended so low that the men feared they would drop into the water. They threw out everything of weight — their food, ropes, even most of their clothing. Fortunately this lightened the balloon enough so that it rose again. At last they were over the French shore. There they opened a valve to allow the gas in the bag to escape gradually and landed, welcomed by an enthusiastic crowd.

At the time that these experiments were being made in France, others were being conducted in the United States. Shortly after his successful trip across the English Channel, Blanchard visited the United States. In Philadelphia people were experimenting with different gases with which to inflate balloons. Blanchard made the first aërial voyage in this country at Philadelphia in the presence of many notables, among whom was George Washington.

As balloons were improved people competed in making longer and longer journeys. In 1836 the "Great Balloon of Nassau," carrying twelve passengers, drifted from England over into Germany, covering a distance of 500 miles. Part of the journey was made at night, and the people had no lights and no way of guiding the ship. They could only guess as to whether land or water, farms or cities, lay below them.

The success of such flights encouraged men to believe that they could cross the ocean in balloons. In 1859 one American aëronaut, John Wise, in preparing to attempt to cross the Atlantic Ocean, actually made a flight over land of 1120 miles. We have no record of any actual attempt to cross the Atlantic Ocean, however.

From this time on balloon ascents became a part of many public celebrations and displays. Traveling circuses took people up in balloons anchored to the earth by ropes. Trapeze performers went up in free balloons, performing their feats as long as they were in view of the crowd. One such performer made 160 flights before his career was ended by his coming down in a storm in Lake Michigan. Although balloons were not very practicable, they gradually came into use in warfare. In the Civil War in the United States, balloons were used for scouting over the enemy's lines.

The third step: engine-driven airships

During all this time from the first flight in 1783 until about the middle of the 19th century, balloons, round in shape, were at the mercy of the winds, and it was almost impossible to steer them. People tried to use sails, oars, and even paddle wheels to steer them but with little success.

Steam engines were being used by that time to propel wagons on roads, locomotives on rails, and boats in water. So aëronauts

said: Why not drive and direct balloons by engines? Many inventors tried to make practicable engine-driven airships. In 1852 Henri Giffard, a French engineer, designed and built a power-driven balloon, shaped somewhat like our great modern airships. This was the first airship which could be steered. (For a modern airship see figure 188.) In the long car which was hung under the balloon was placed a small steam engine which Giffard had made specially for his airship. The experiment was regarded as a success, for the balloon attained a speed of four miles an hour in still air.

This really marked the beginning of the development of engine-driven airships, or "dirigibles." These aircraft were capable of being directed by the pilot from within the airship itself, somewhat as an automobile is directed. They were improved very slowly, however, because of the lack of a light, powerful engine. You know the story of how that was secured with the invention of the gas engine. No sooner was the gas engine made practicable and applied to automobiles than inventors used it in airships. In 1898 Alberto Santos-Dumont, a Brazilian of French parentage, succeeded in propelling an airship with a gas motor.

The gas engine was not only lighter but it was also safer than the steam engine. There was less danger of explosion of the hydrogen gas in the balloon. There were corresponding improvements in the bag of the balloon itself. The bag was composed of compartments, each one separate from the others. Even should a leak occur in one compartment the gas in the others would keep the bag aloft. Furthermore, an air space was left between the separate bags and the outside bag which enclosed them all. This helped to keep the temperature about the same at all altitudes, thus preventing the loss of gas and adding to the security of the passengers.

At the same time in Germany (about 1900) further improvements were being made in airships by Count Ferdinand von Zeppelin. In place of the collapsible cloth bag, he built a rigid aluminum frame to hold the separate bags of gas. Airships constructed with these metal frames were much stronger and more easily propelled and steered. This is the kind of airship most widely used for passengers today.

The dirigibles built by Count Zeppelin all made successful flights. But first one and then another was wrecked by storm. The German people had faith in the experiments, however, and subscribed $1,500,000 to build new ships.

During the World War Germany built about 100 airships of several different types. After the war she began to build airships for other countries. The *Los Angeles* is one that was built

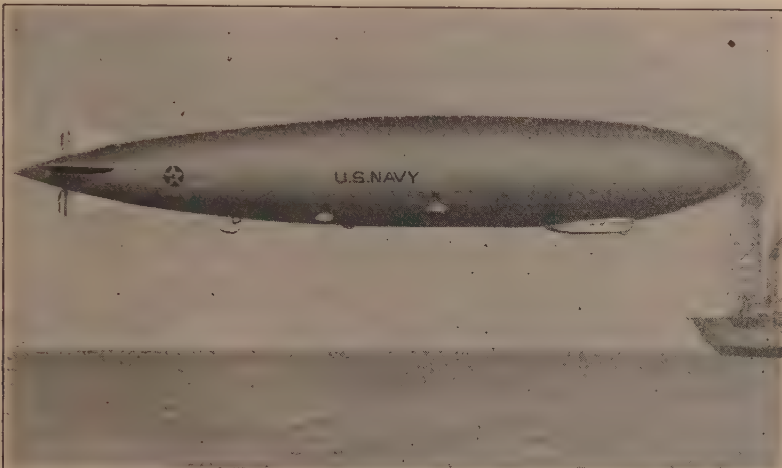

Fig. 188. The *Los Angeles* moored to the mast of a ship

in Germany for the United States navy. It crossed from Germany to Lakehurst, New Jersey, in 1924 — over 5000 miles — in 81 hours, averaging about 60 miles an hour.

Recently another gas — helium — has been discovered to be better than hydrogen for airships. This gas has the great advantage of being noninflammable; that is, it will not burn as will hydrogen. This gas is extremely expensive, however, and the United States is the only country known at present to have a supply of it in usable quantities.

2. The Invention of Heavier-than-Air Craft

Airships are well named, for they float in the air as boats float in the water. Even the modern ones with their rigid metal frames must be lighter than air, since they depend upon their lightness to keep them aloft.

Airplanes, however, which are heavier than air, depend upon *speed.* Any object propelled through the air rapidly enough will keep aloft. This you can illustrate for yourself by "sailing" a small piece of cardboard. So you see that *with heavier-than-air machines speed is absolutely necessary.* It was the lack of engines to provide the speed that held men back so long from being able to fly in heavier-than-air machines.

The first heavier-than-air machines were engineless gliders

The first airplanes were merely gliders. They had no engines at all. They were made in many shapes, some with queer batlike wings, others with planes slanted at different angles to catch the wind. The glider was fastened to the body of the flyer by straps. It was set in motion by the flyer's running with it from the summit of a low hill. With a strong wind blowing, the early gliders lost movement rapidly and could carry people no more than 100 feet.

With gliders, as with balloons, however, men studied scientifically the problem of keeping aloft in the air. For example, they made careful studies of how birds flew and constructed their gliders on the principles which they discovered. A French sailor who had some success with gliders built his in imitation of the wings of the albatross.

One of the most famous of the first experimenters was a German, Otto Lilienthal (see figure 189). He published the results of his observations of the way in which birds fly in a book called *Bird Flights as the Basis of Aviation.* He applied his knowledge of the flight of birds in his experiments with gliders and made successful flights in 1891. Lilienthal made a great addition to men's knowledge of flying by learning how to control his planes in the wind. Gliders were difficult to steer and hard to keep level when the wind came with more force on one side than on the other. Lilienthal developed great skill in using the weight of his body to maintain his balance. As the wind caught the surface of the glider he would turn and twist, shifting his weight to counteract the overturning effect of the wind. For years Lilienthal worked, constantly discovering new facts about the winds, con-

FIG. 189. The Lilienthal glider of 1896 demonstrated in flight. (Courtesy of *Aëro Digest*, New York)

stantly improving his gliders, and succeeding with longer and longer flights. One day, however, in testing a steering device on a new glider, he lost control, fell, and was killed. It is believed that had he lived a little longer he would have tried motors and might have succeeded in making the first engine-driven airplane. Lilienthal, however, had accomplished the first difficult task; he had learned how to control his planes in winds.

At last men found out how to propel gliders by engines

Fifty years before Lilienthal's experiments with gliders inventors had tried to propel model flying machines by small steam engines. In 1840, for example, an Englishman named Henson designed a model of an "aërial steam carriage." In shape this resembled somewhat our present monoplanes, being constructed with wide wings and propelled by fanlike wheels resembling the propellers used in airplanes today. Henson was unable to go on with his experiments, however, because the public was not interested enough to subscribe money. Another Englishman tried an engine-driven model in 1848. This one, which actually raised itself a short distance from the ground, was designed somewhat in accordance with the plan of the artist Leonardo da Vinci.

C. A. Parsons, the inventor of the steam turbine, of whom you read in Chapter VII, built a monoplane, the wings of which were eleven feet across. He operated it with a steam engine and a boiler. Although the steam engine was really too heavy for the airplane, Parsons's model actually stayed in the air for more than a hundred yards.

In the meantime the gas engine had been invented. We have already learned how it was applied successfully to automobiles as early as 1892 and to airships in 1898. At the time when American scientists and inventors were nearing success in airplanes propelled by gas engines, the inventors, Samuel P. Langley and Orville and Wilbur Wright were the leaders in this experimenting. Langley was aided by the officials of the United States War Department, who saw the possibility that airplanes might be used successfully in warfare. From the War Department Langley and his assistant received encouragement and money with which to build a strong, man-carrying airplane to be propelled by an engine. They made themselves a special small and light gas engine. They equipped their plane with an automobile steering wheel, which made it easier to manage.

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Fig. 190. The original Langley machine on a house-boat at Quantico, Virginia, just before its first trial on October 7, 1903

By the autumn of 1903 everything was ready for a test flight. Two trials were made, with Langley's assistant operating the machine. In each case something went wrong with the launching and the machine was unable to rise. Disappointed by the failure of his machine, Langley gave up his experiments. He died soon after. In spite of the fact that his machine did not actually work, he is remembered as the "Father of Aviation."

December 17, 1903: success at last!

Shortly after the failure of the Langley machine, Orville and Wilbur Wright made the first sustained flight in a man-carrying airplane. For 59 seconds (an undreamed-of length of time) their heavier-than-air machine stayed off the ground, covering 260 yards.

The Wright brothers' feat illustrated, as had that of many inventors of machines before them, the fact that practical success comes generally as a result of long scientific study and careful experimentation. For some time the Wright brothers had been preparing for their successful flight. They had been experimenting with gliders, accustoming themselves to the effects of the wind on planes. They not only learned from published studies of wind and weather but they also experimented with the effect of wind upon airplane models. For example, they built a small "wind tunnel," a wooden tube six feet long and sixteen inches around. They blew air through this tunnel by means of a revolving fan and tested the effect of the air pressure on many tiny airplanes with wings of various shapes and materials. Even today, although much more is known about the construction of airplanes, enormous experimental wind tunnels are used to test out the planes. The Wrights, however, deserve great credit for being among the first to test the action of planes scientifically instead of relying on mere theory and guesswork.

FIG. 191. This is the Wright airplane which maintained itself in the air for 260 yards at Kitty Hawk, North Carolina, on December 17, 1903

Not only did the Wright brothers spend years practicing with gliders and studying the control of wings in air currents, but they also designed a gas engine of the right size and power. So well did they learn to make airplane motors that today the Wright motors are widely used. The plane in which Colonel Charles A. Lindbergh flew to Paris in 1927 was equipped with a Wright motor.

Following their first success on December 17, 1903, the Wright brothers continued their careful experiments, improving their motors and the various parts of their machine. By 1908 Wright airplanes had remained aloft more than an hour. European countries gave the Wright brothers almost immediate recognition. They traveled in various European countries, introducing and demonstrating their plane. In France, especially, there was much interest in aviation. This was greatly stimulated by the visits which the Wright brothers made to a number of French cities.

In 1906 Santos-Dumont, the builder of the most successful dirigible up to 1900, made the first officially recognized European airplane trip. In 1909 another Frenchman, Louis Blériot, crossed the English Channel in an airplane. This was regarded as a great event. Most people had doubted that an airplane could cross the channel, even though a balloon had already done so.

Slowly the people of the United States accepted aviation. In 1910 Glenn Curtiss devised the first successful hydroplane. His plane had boatlike runners instead of wheels. It could both alight on and take off from water. Curtiss' success led later inventors to devise means whereby airplanes could alight either on water or on land. Airplanes of this kind are called *amphibian* planes.

Nevertheless, most people were skeptical and slow to take up aviation. Even by 1911, eight years after the Wrights had demonstrated the practicability of heavier-than-air machines, there were only 25 certified air pilots in the United States; at the same time France had 383 licensed aviators. All the other larger European countries had more pilots than the United States had. The airplane was still regarded here as a novelty, a means of entertainment. Like balloons, airplanes had their place on the programs of circuses and country fairs.

The World War brought Standardization and Mass Production of Airplanes

Then came the World War, 1914–1918, and aviation took its place as one of the four great means of transportation. At the outbreak of the world struggle none of the chief countries had many airplanes. At the end there were tens of thousands of per-

fected planes and trained pilots. In response to the great demand for cheap and quick mass production each of the leading countries set its engineers and scientists at the task of improving the airplane. These men knew that mass production depended upon having machines with simple, standardized parts. So the same things happened in aviation that had already taken place in all the machine industries: specialization of work and standardization of machinery. The following account illustrates what happened:

When our country entered the World War in 1917 the army's plans included the making of 3000 airplanes. Almost immediately the plans were changed, and within eighteen months 15,000 planes had been built and equipped with motors. The most important step in this mass production was the design of a standardized motor, — that is, a motor with all its parts made in standard shapes and sizes. This was called the Liberty motor. It was perfected by the joint work of many aëronautical engineers and within a short time it was propelling thousands of planes over the enemy lines in Europe.

The World War had another important effect upon aviation. It brought about the training of a very large number of young, intelligent men, and when the war closed there were thousands of expert airplane pilots. While many of these went into the airmail service, of which you will read later, others engaged in commercial air transportation. Furthermore, many of the army planes were sold to private citizens for commercial or recreational use.

Aviation rapidly became a matter of public interest, and of many uses. The Forest Service adopted the airplane for the use of many of its rangers. The Department of Agriculture used it to spray trees and crops in pest-infested regions. Coast guards used it for patrol, engineers for surveying and mapping the country, and meteorologists for making weather and wind reports. Government employees fed starving birds from airplanes and rounded up reindeer in arctic regions. Prospectors raced by this swift means of transportation to newly opened diamond fields. People were rescued from river floods and from mountain snows by means of airplanes. Scientists searching for hidden ancient cities located them from aircraft by noting from great heights unusual appearances on the surface of the earth.

Airways and Landing Fields

Airplanes need well-marked-out routes and convenient landing fields, and for night flying these routes must be lighted. To accomplish this, lights have been invented that pierce even through fog and storm, guiding the airplane or airship on its way.

Fig. 192. The highest beacon light in the world. This 5,000,000-candle-power beacon is located in the Rocky Mountains, on Sherman Hill, between Cheyenne and Laramie, Wyoming, 8600 feet above sea level. It is used to guide air-mail pilots on their night flights. (Courtesy of the United States Post Office Department)

If we follow the night-mail plane we shall see it leave a well-lighted field. Lights along the runway help the pilot to take off from the course. Beacons point the way toward his next goal. As he flies over the land he feels secure, for he knows that if anything goes wrong there are emergency fields along his route where he can land if forced down. Moreover, for the most part his route has been carefully chosen and charted, over fairly even country, where landing would not be difficult. When the mountains are reached there are more landing places, and the guiding lights appear at more frequent intervals. Some of the great beacons are of 500,000,000 candle power — lamps so powerful that their beams can be seen 150 miles. There are, in addition, lesser lights about ten miles apart. The whole route from coast to coast is lighted, so that the night mail can be carried safely.

If you compare the map of figure 193 with figure 152 and figure 166, you will see that the routes parallel each other. This is only natural, for the large cities should be connected by air service just as they are by other means of transportation.

At first landing fields were located at a distance from large cities, as this seemed safer, but the new ones are being built near cities. Business men who make use of airplanes in order to travel from city to city naturally want to reach their destination with the least possible delay. Many large cities have several landing fields just as they have several railroad stations. These fields are equipped not only for airplanes but also for the convenience of passengers.

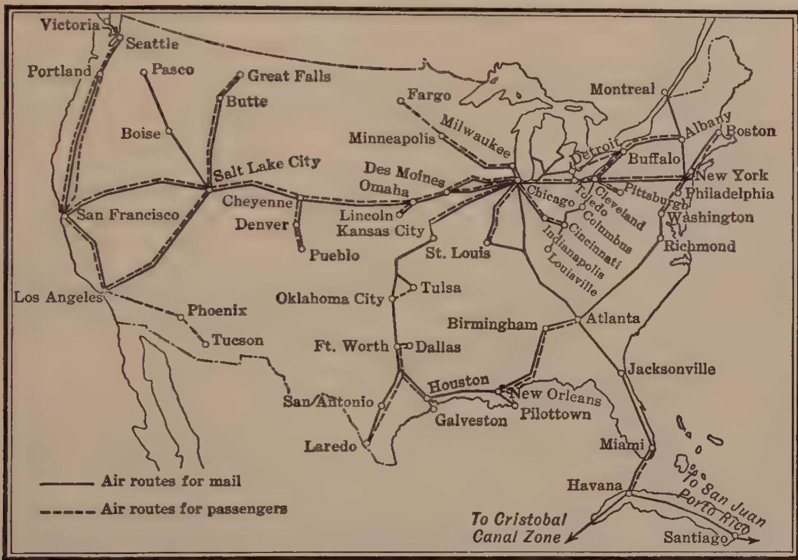

FIG. 193. Map of the United States airways

Besides lighting him on his way, the stations give the aviator his directions by radio. Each plane is equipped with a radio compass, a delicate instrument that registers signals sent out by radio from the stations. These signals indicate to the pilot whether he is on his direct course or whether he is steering too far to the right or the left of it.

The stations also give the latest weather reports. Because of this the aviator can often avoid storms by changing the direction in which his airplane is flying. Many stations have great lighted arrows, like weather vanes, indicating the direction of the wind. The airplane and airship are as dependent on wind and weather as are sailing ships at sea, and navigating the air requires much the same knowledge and equipment as navigating the ocean.

Today people hire an airplane as they would an automobile, to take them rapidly to some place. But there are well-developed passenger lines too, just as there are mail lines. In 1928 there were 12,000 miles of air routes regularly flown in the United States, and in that year the total number of landing fields was 3806.

To survey some of the existing airways of the United States, Colonel Charles A. Lindbergh made an air tour of 22,350 miles, visiting 82 cities. He then set out to blaze a new trail on a good-will trip to some of our neighbors on the American continent. In December, 1927, he made a nonstop flight from Washington, D.C., to Mexico City, a distance of 2000 miles. He then went on to Guatemala, British Honduras, Salvador, Honduras, Nicaragua, Costa Rica, Panama, Colombia, and Venezuela, returning by way of the Virgin Islands, Porto Rico, Santo Domingo, Haiti, and Cuba. Europe already has air connection with South America, and the United States is commencing commercial and mail service with that continent.

Famous Flights

Nothing illustrates better the rapidity with which aviation has been proved to be practicable than the swiftly changing history of flying records. As recently as 1911 the first flight that spanned the United States required 49 days — from September 17 to November 5. It was made in an airplane equipped with a small engine. Many breakdowns occurred, and many landings had to be made for fuel and repairs. Only thirteen years later the continent was crossed in the first nonstop flight in 21 hours and 48 minutes. In that short time engines had increased tenfold in size and efficiency. Every year this nonstop record is being surpassed.

In the meantime the interest of the entire world has centered on the attempts of heroic aviators to fly the Atlantic. In May, 1919, an American naval flying boat, the *NC-4*, with a crew of five men, crossed the Atlantic in a series of flights: first from New York City to Halifax, then from Halifax over the shortest route to land in the Azores Islands, and then from the Azores to Lisbon, Portugal. This first transatlantic flight took place just

a hundred years after the first steam-driven ship had crossed the Atlantic. Only a month later, June 14, 1919, two Englishmen made the first nonstop flight directly across the ocean from Newfoundland to Ireland—a distance of 1880 miles—in sixteen hours.

These flights were made by heavier-than-air craft. In the meantime other daring men were experimenting with long-distance flights in lighter-than-air craft. In July, 1919, a British dirigible

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Fig. 194. Colonel Charles A. Lindbergh and the *Spirit of St. Louis*, in which he flew from New York to Paris, May 20–21, 1927

made a nonstop flight from Edinburgh, Scotland, to New York City, and shortly afterward returned home safely. In the autumn of 1928 the *Graf Zeppelin*, carrying twenty passengers, made a continuous nonstop flight from the interior of Germany to New York City by way of the long southern route over Spain, the Azores, and the Bahama Islands, — a total distance of more than 6000 miles — in about 112 hours.

Adventurous aviators tried to establish one new record after another. In 1924 a round-the-world flight, covering more than 27,000 miles, was made by two United States army aviators in 175 days.

In 1926 the airplane and the dirigible were both shown to be practicable in arctic regions. Commander Richard Byrd and his assistant, Floyd Bennett, flew in an airplane from Spitzbergen to the north pole and back. A month later the Amundsen-Ellsworth-Nobile expedition flew the dirigible *Norge* from Spitzbergen across the north pole to Alaska. Two years later Commander

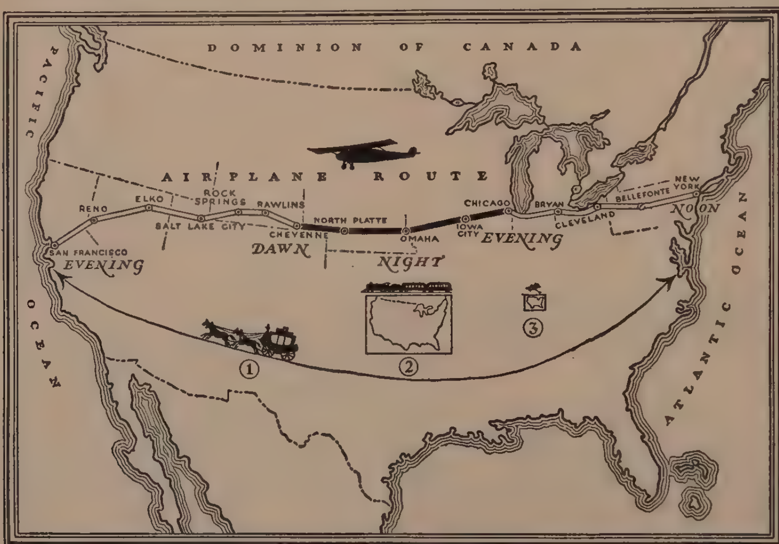

FIG. 195. Here are shown three maps, two small ones within the large one. The large map (1) illustrates the size of the United States as measured by the time needed to cross it during the period of the stagecoach; the next smaller map (2) shows the country reduced in size by railroad transportation; the little map (3) shows how the airplane shrinks the distance between the Atlantic and the Pacific. Can you explain how the size of these maps illustrates the increasing speed of transportation? (Courtesy of the United States Post Office Department)

Byrd, after the most elaborate preparations and scientific planning, began his expedition to explore the unknown land around the south pole. In this expedition the airplane was the most important means of exploration.

The most-talked-of transatlantic flight, however, occurred on May 20 and 21, 1927. The youthful Charles A. Lindbergh, previously a mail aviator, flew alone from New York to Paris, 3610 miles, in 33½ hours. Lindbergh's remarkable success was achieved not only because of his great personal courage but because of re-

markable skill in flying and intelligent planning of the details of his flight. Lindbergh's flight, like that of Commander Byrd and other record-holders, illustrates again the accuracy of Leonardo da Vinci's prediction that "flying will only be achieved by mathematics." By mathematics Leonardo meant careful scientific calculation.

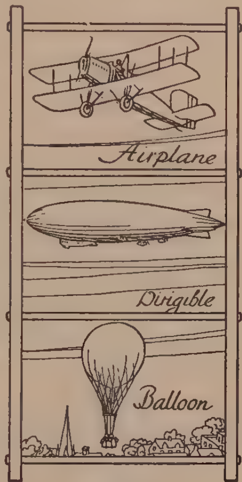

FIG. 196

Each year aviation records — endurance records, altitude records, and speed records — are being exceeded. In 1926 a French officer, Lieutenant Champion, ascended to a height of more than seven miles above sea level, or 9000 feet higher than the highest mountain on the earth, Mount Everest, in the Himalayas. As with altitude records, so it is with records of endurance. During January 1–7, 1929, the *Question Mark*, a United States army plane, by means of refueling in the air, broke all records for a sustained flight, remaining aloft 150 hours, 40 minutes, and 14 seconds. What a contrast to the first flight of Orville and Wilbur Wright in 1903, which lasted 59 seconds! It is in speed that the airplane has made the most astonishing records. In 1927 a speed of 282.5 miles an hour was recorded, while more recently a record of 314 miles an hour was reported.

We live indeed in an age of increasing speed — on land, on water, and in the air. Note the following interesting comparison of speed records:[1]

Man running at the rate of	21 miles an hour
Horse running at the rate of	39 miles an hour
Bicycle at the rate of	57 miles an hour
Dirigible airship at the rate of	81 miles an hour
Motorboat at the rate of	93 miles an hour
Motorcycle at the rate of	112 miles an hour
Railroad train at the rate of	120 miles an hour
Automobile at the rate of	231 miles an hour
Airplane at the rate of	282 miles an hour

No doubt the record of the power-driven vehicles shown in this list will be greatly surpassed in the years to come.

[1] Adapted from H. H. Arnold's *Airmen and Aircraft* (Ronald Press Company, 1926).

INTERESTING READINGS FROM WHICH YOU CAN GET ADDITIONAL INFORMATION

Books

*BRIDGES, T. C. The Young Folk's Book of Invention. Little, Brown & Company, Boston, 1926.

An excellent description. See Chapter XIX (Balloons and Airships) and Chapter XX (The Airplane).

BYRD, RICHARD E. Skyward. G. P. Putnam's Sons, New York, 1928.

This book records a number of Byrd's flights, including that to the North Pole.

CHARNLEY, MITCHEL V. The Boy's Life of the Wright Brothers. Harper & Brothers, New York, 1928.

Interesting and easy to read.

*KAEMPFFERT, WALDEMAR B. (Editor). A Popular History of American Invention. Charles Scribner's Sons, New York, 1924.

Volume I, Part I, Chapter V (Man Conquers the Air).

*KEIR, MALCOLM. The March of Commerce (Volume IV of The Pageant of America). Yale University Press, New Haven, 1927.

Chapter XII (Aviation).

LINDBERGH, CHARLES A. "We." G. P. Putnam's Sons, New York, 1927.

A very interesting account of the author's exploits in aviation.

WILLIAMS, ARCHIBALD. Conquering the Air. Thomas Nelson & Sons, New York, 1926.

An interesting book with stories of early and of modern aviation, including polar flights, nonstop continent and ocean flights, etc.

Magazine Articles

*BYRD, RICHARD E., "Our Transatlantic Flight," *National Geographic Magazine*, September, 1927, pp. 347–368.

"Five Miles a Minute at Venice," *Literary Digest*, October 8, 1927, p. 13.

*"Lindbergh's Leap to Paris and Fame," *Literary Digest*, June 4, 1927, pp. 5–8.

"Man's Amazing Progress in Conquering the Air," *National Geographic Magazine*, July, 1927, pp. 93–122.

"Our Civil Aviation now Leading the World," *Literary Digest*, November 13, 1926, pp. 23–24.

"Seeing America from the *Shenandoah*," *National Geographic Magazine*, January, 1925, pp. 1–47.

*"The Non-Stop Flight across America," *National Geographic Magazine*, July, 1924, pp. 1–83.

CHAPTER XVIII

COMMUNICATION BY WRITTEN MESSAGES

A Contrast

Communication in 1828

Toward the close of a cold December afternoon in 1828 a wearied horse and rider laboriously plodded along the Lebanon Road to Nashville, Tennessee. It was fine rolling country that the horseman had been riding through. From Washington he had come up the winding Potomac, over the Appalachians, down through the gaps in the mountains, and on over the new, rough Kentucky and Tennessee roads. As he neared Lebanon on the Nashville road a passing farmer directed him on his way: "General Andrew Jackson? Oh yes, straight ahead and first road to your left. It's the Hermitage you want. That's where Andy lives. Big house, set back amongst the trees. Fine place he has. Hope you've no bad news for 'Old Hickory'?"

The messenger from Washington smiled. "No; good news I hope he'll think it is." He leaned closer and spoke a few crisp words. The other gasped in astonishment. "You don't say! Not our Andy Jackson! What will they do now down at Washington? I'll hurry on and tell the folks the news!"

An hour later the lone rider pulled his tired and sweating horse up to the door of the Hermitage.

"Is the President at home?" came the query to the surprised colored servants gathered at the door.

"The President? You don't tell me our Massa's done gone and been elected president!"

"That's what I do. I have the official notice here. Been on the road from Washington four full weeks. He was elected November 10th. This is December 9th. And a turrible trip it's been, too. Used seventeen horses trying to break a record. Roads bad and couldn't make any time at all. People around here don't

seem to mind the mud. They've been telling me the road's 'middling good' ever since I left Cumberland, three weeks ago. And the mud's been over my boot-tops a third of the way!"

Communication in 1928

And how soon does the newly elected president of the United States hear of his election in these days? A month later? Two weeks? A week?

No; the voting stops at six o'clock in the afternoon of election day. By the time the presidential candidate is eating dinner the campaign offices at his home are buzzing with action. Special telegraph and telephone wires connect it with the central stations of the large cities. Messengers are going and coming. By seven o'clock the candidate's family is on tiptoe with excitement. Telephone calls and radio messages come constantly.

"Tell the chief that 2141 up-state precincts in New York gave him a lead of 7800."

"Omaha, Nebraska, goes for our man by 22,000. It looks like a landslide in the Middle West."

A call comes from Chicago. "The Middle West is going for you strong. Three fourths of the districts in Illinois, Michigan, Wisconsin, and Iowa have wired in their returns. You are leading in every state!"

By ten or eleven — midnight at the latest, unless the election is very, very close — the successful candidate can go to bed knowing that he will be the next president of the United States, and in the morning half a dozen newspapers recount for him how it was done.

Not only does the presidential candidate know the result of the election the same day the voting takes place, but almost every person in the United States can have the same knowledge at the same time. Thousands of telephone and telegraph wires carry messages of the progress of the election to the communities of the country. Soon the news is given out to the radio stations, which broadcast it to every corner of the land. Metropolitan dailies issue "extras" late in the afternoon and during the evening, which inform at least the city populations of the details of

the voting. Swiftly to all parts of the country goes the message "A new president is elected!"

Not only do the American people know the election results immediately — all the rest of the world knows as well. The news is flashed by submarine cable, wireless telephone, and telegraph to the other five continents of the earth. A century ago sailing ships were the fastest means of transmitting news to foreign lands, and sailing ships took weeks to cross the ocean. A hundred years ago words could be communicated no more rapidly than the speed of transportation. Written messages traveled no faster than horseback rider or sailing boat.

But times have certainly changed! Today the airplane, the automobile, and the railroad express train have greatly increased the speed of transportation and communication. But even these methods are far outstripped by the telegraph, the telephone, and the radio. Certainly, today transportation is amazingly rapid! But we flash news so rapidly from one place to another that we speak of modern communication as almost instantaneous. To appreciate its rapidity, however, we should see for contrast the slow methods of communication employed long, long ago. These we shall read about in this chapter.

Man's Long Struggle to learn to Write

It is so easy to communicate quickly with other people today that we seldom stop to think how remarkable it is, or to consider how difficult communication of any kind was in past ages. If we go far enough back in history, we find that there was a long time before man could make his neighbor understand what he meant even by making signs. To learn to use words, either spoken or written, required ages and ages.

You have already learned that a long time passed before man was able to get a comfortable living out of the earth. Many thousands of years passed before he knew how to make fire. Many more passed before he learned how to use it for cooking, for removing the impurities from iron, and for other purposes. Still more years passed before he learned to make crude tools and implements to increase the power of his own muscles, and before he

learned to make wheels to reduce the labor required to drag loads. You have learned that only within the past 100 years has he been able to make power by means of great engines and to transmit that power to wheels long distances away. Let us see whether the story of his effort to find ways of communication is similar to the story of his other long struggles.

We do not know the very earliest part of the history of how man learned to make words and to speak with his fellows. Scientists have made different guesses to explain the way in which men learned to speak words to each other. Some think that they began by uttering cries of warning or excited exclamations when in danger. Even today we have in our vocabularies sounds that are mere exclamations, "Hey!" "Oh!" "Ah!" "M-m-m!"

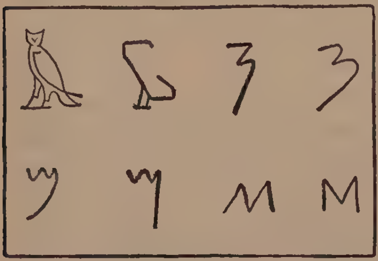

FIG. 197. This illustrates how single letters grew out of picture writing among primitive peoples. Thousands of years ago the letter *M*, for example, was developed by various peoples from the Egyptian word *mulak*, meaning "owl." At first the people drew the owl to stand for the word *mulak*. The successive diagrams show the way in which after a long time the picture of an owl became the letter *M*

Whatever may have been the origin of man's speech, it is certain that for a very long time men lived on the earth without any means of communication with one another except speech and gestures. Scientists feel very sure that primitive men had command of only a few hundred words. What a contrast to the vocabulary of a high-school student today, which consists of probably 10,000 words!

Then after many ages men learned to write. First they tried to convey ideas to their neighbors by making drawings of objects. This was called picture writing.

Then after more thousands of years people learned how to simplify their picture writing and make alphabets consisting of letters each of which stood for a separate sound. (See figure 197.) These letters were combined into words and used in writing. Thus our own alphabet, which consists of 26 letters, grew out of the picture writing of the Egyptians and the alphabets of the Phœni-

cians, the Greeks, and the Romans, who lived more than 2000 years ago. The Egyptians wrote first with pictures, but after a long time they learned how to make letters and to put them together in words. The Phœnicians, who lived on the Mediterranean Sea near the Egyptians, borrowed and improved the Egyptians' alphabet. In their voyages over the Mediterranean to Greece and Rome they spread this idea of writing with letters. The Romans improved it still more, and for 2000 years their form of alphabet and way of writing has been used in Europe. The letters we use today are much like those used by the early Romans.

One important point, therefore, we have tried to make in this brief outline: Man required hundreds of thousands of years to learn how to communicate by writing.

How were Written Messages sent Thousands of Years Ago?

Our early records of history tell us that runners carried messages written on a kind of paper called *papyrus* or on cylinders of sun-baked clay or on tablets of stone. These runners often traveled fast, but even so it took a long time to send messages more than a few miles. We are told that

> when Haman sent letters by runners to the people of Israel and Judea, ordering that the Jews be killed on a certain date, the massacre was scheduled to be carried out on a date nearly eleven months from the time when the runners started out, as it required nearly a year to notify the people in all the provinces.[1]

Trained runners were also used as messengers by the Greeks 2500 years ago. History records many unusual long-distance runs made by these Greek messengers. One of the most famous runners was Pheidippides, who is reported to have run from Athens to Sparta, a distance of 140 miles, in less than two days.

The earliest regular sending of messages of which we have any record was by relays of men and horses stationed at regular intervals. The Chinese empire, vast in extent, was held together by

[1] We acknowledge our indebtedness to the New York Telephone Company for pictures and informational material concerning the early history of communication.

such a postal system. Marco Polo, a Venetian who visited China about A. D. 1275, describes it as follows:

From the city of Kanbalu there are many roads leading to the different provinces, and upon each of these, at the distance of 25 or 30 miles, there are stations, with houses of accommodation for travelers, called posthouses. These are large and handsome stone buildings, having several well-furnished apartments hung with silk and provided with everything suitable to persons of rank.... At each station 400 good horses are kept in constant readiness, in order that all messengers going and coming upon the business of the Grand Khan [ruler], and all ambassadors, may have relays and, leaving their jaded horses, be supplied with fresh ones.

Fig. 198. How the artist imagines a Greek runner of 2500 years ago. These trained runners were the chief means of long-distance communication

In the intermediate space *between the posthouses* there are small villages settled at the distance of every three miles, which may contain, one with another, about 40 cottages. In these are stationed the foot messengers, likewise employed in the service of His Majesty. They wear girdles around their waists, to which several small bells are attached, in order that their coming may be perceived at a distance; and as they run only three miles, that is, from one of these foot-stations to another next adjoining, the noise serves to give notice of their approach, and preparation is accordingly made by a fresh courier to proceed with the packet instantly upon the arrival of the former. Thus it is so expeditiously conveyed from station to station that in the course of two days and two nights His Majesty receives distant intelligence that in the ordinary mode could not be obtained in less than ten days.

This postal system of the Chinese at the time of Marco Polo was mainly for the use of the government. Royal orders and directions to military and state officials comprised most of the messages sent.

Governments in all times and all over the world have found such systems of communication absolutely necessary for keeping in touch with all parts of their countries and for controlling their armies. In England and in the other European countries the first regular messengers were those who carried dispatches for the king.

In later times, however, as trade within countries and between countries grew greatly, merchants and manufacturers became the ones to see to it that a rapid system of communication was built. Like the kings and rulers before them, these business men have always seen that, in order that trade may grow, communities and countries must be bound together by means of communication. In many instances, therefore, it has been merchants who have established postal systems. Unless the merchant was a house-to-house peddler, he had no way of reaching his customers except by letter. If his business was large and he had shops in several cities, he needed a regular way of keeping in touch with them. Business men as well as rulers and citizens in general, therefore, have always felt the need of a regular means of communication.

How our Own Country managed before the Days of the Telegraph, the Telephone, and the Radio

In 1790 nearly all the American people lived on the Atlantic coastal plain. New Yorkers, for example, spoke of their trade with Buffalo and Pittsburgh as "trading with the West." There were no trains, no telegraphs, no telephones, no radios, and no airplanes. As you have learned, transportation was exceedingly difficult and slow. Since communication, of course, depended on transportation, it too was not only slow but uncertain.

Consider the development of the postal system about the middle of the 1700's. Mail started from New York to Philadelphia, for example, — a distance of not quite 100 miles, — three times a week, but once having started, it was not sure of arriving at any set time. The mail traveled by stagecoach over very bad roads, but the mail-carrying stagecoach was rapid when compared with most of the travel of its day. The gradual improvement of roads was brought about in part by the desire for a better postal service between towns and colonies.

Benjamin Franklin, prominent in so many activities of that day, was one of the first leaders to see how necessary it was to have rapid and safe communication. He organized post offices and postal routes as early as 1753, and became himself the first Postmaster-General. Roads improved so slowly, however, that by 1790 there were only 75 post offices in the entire country. There was little recognition of their value by the people, even by the business men of the various states. Because each local post office had to be self-supporting, no letters were sent out until enough had been deposited in the post office to pay the cost of sending

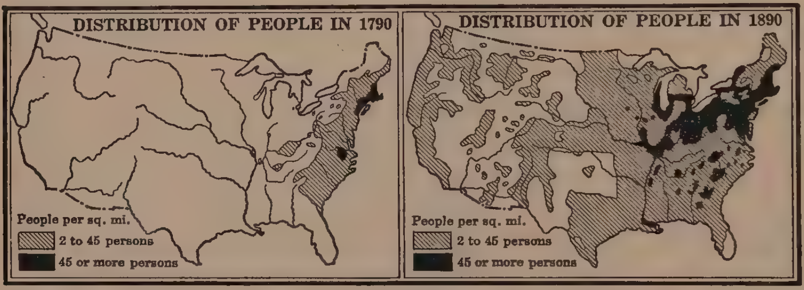

FIG. 199. These two maps show where the American people lived in 1790 and 1890. In 1790, at the beginning of George Washington's administration as first president of the United States, there were 4,000,000 people living on the eastern coast of North America. In 1890, there were 63,000,000 Americans scattered in thousands of communities over the entire continent between the Atlantic and the Pacific. On each map the white areas show where there were less than two people per square mile

by stagecoach. Letters were carried but no newspapers, books, or parcels. Furthermore, the charge, which varied from about six cents to 25 cents, was decided not by weight as it is today, but by the distance the letter was going.

This was the condition of the postal service about 1790 when most of the people lived along the Atlantic seaboard and distances between the East and the West were not more than 200 miles. Then came the great westward movement of our people. Within 50 years they had explored and begun to settle the entire country from coast to coast. In another 50 years cities had sprung up, dotting the forests, prairies, and plains of the United States to the western coast.

In the meanwhile, all this spreading out and multiplying of a people had brought with it the great problem of communication.

How could men move their goods — coal, wheat, corn, cattle, iron, steel, and manufactured articles—from place to place? How could they move themselves from one part of the country to another? How could they continue to communicate with each other as they got farther and farther apart? Many people feared that as the great continent was settled the sections would split up into several different nations. We know, of course, that this did not happen. It was prevented largely by the rapid improvement of means of transportation and communication.

The pony express was the pioneers' most rapid means of communication

In colonial times, as you have just learned, the mail was sent from city to city. But what about the pioneer who lived miles from towns or even villages? Until well past 1850 the post-rider was still the pioneers' best means of communication with distant places. After 1830, as the railroads multiplied in the settled districts and also spread farther west, they carried the mail to the fast-growing communities. But even as late as 1850 railroads had not been built west of Missouri. Since thousands of settlers were established beyond the Rocky Mountains, mail communication had to be maintained in some way. So the pony express was started. It took up the mail where the railroad ended. The

Fig. 200. This illustrates the pony express, the only means of rapid communication on the Western plains before the completion of the first transcontinental railroad in 1869. Pony-express stations were built at regular intervals. Each rider rode about 50 miles. (Courtesy of the American Express Company)

last railroad stop was St. Joseph, Missouri. Between this city and the Pacific coast, stations were set up at regular intervals. From station to station the mail was carried by messengers on horseback. Uncle Nick Wilson, one of the first riders of the pony express, gives us a glimpse of the way the mail was carried at that time.

A great "powwow" was going on about the pony express coming through the country. The company had begun to build its roads and stations. These stations were about ten miles apart. They were placed as near to a spring or other watering place as possible. There were two kinds of them, the "home station" and the "way station." At the way stations the riders changed horses. At the home stations, which were about 50 miles from each other, the riders were changed, and there they ate their meals and slept.

FIG. 201. This is the Overland Mail Company's coach, used in 1858. It carried passengers as well as mail. (Courtesy of the United States Post Office Department)

When we were hired to ride the express, we had to go before a justice of the peace and swear we would be at our post at all times and not go farther than 100 yards from the station except when carrying the mail. When we started out we were not to turn back, no matter what happened, until we had delivered the mail to the next station. We must be ready to start back at a half-minute's notice, day or night, rain or shine, Indians or no Indians.

Well, the time came that we had to start. On the afternoon of April 3, 1860, at a signal cannon shot, a pony rider left St. Joseph, Missouri; and the same moment another left Sacramento, California, one speeding west, and the other east, over plains, mountains, and desert. Night and day the race was kept up by the different riders and their swift horses until the mail was carried through. Then they turned and dashed back over the same trail again. Each man would make about 50 miles a day, changing horses four or five times to do it.[1]

[1] From E. N. Wilson and Howard R. Driggs's *The White Indian Boy*. Copyrighted, 1919, by the World Book Company, publishers, Yonkers-on-Hudson, New York.

Nine years after the establishment of the first Western pony express, the first transcontinental railroad was completed; but for years after this time, many Western communities continued to receive their mail by means of the pony express. Gradually it was discontinued as other through railroads and many branch lines were built.

TODAY, HOWEVER, THE UNITED STATES HAS A NATIONAL POSTAL SERVICE WHICH HELPS TO BIND OUR PEOPLE TOGETHER

Contrast the pony express of 1860 with the mail car of one of our transcontinental express trains. In 1860, with the swiftest express riders and stagecoaches, it took two weeks to carry a letter from the Mississippi River to San Francisco. With the development of the transcontinental express trains, mail can now be carried across the United States in about 100 hours.

The United States postal service today is one of the biggest single businesses in the world. Each year it delivers an average of a letter every two days to each man, woman, and child in the United States. For every second of the 24 hours of every day 389 letters are dropped into letter boxes. Mail is delivered by wagon, by automobile, by railroad train, by air-

FIG. 202. The upper picture shows how the mail was carried by the postrider about 1800. Note the "corduroy" road and the cabin made of logs. The lower picture shows how the mail was carried less than 100 years later. (Courtesy of the United States Post Office Department)

plane, by dog train, as well as by postmen on foot. Every known kind of transportation is used to do the efficient work of 51,000 post offices. Contrast the following summary of the United States postal system in a recent year with the 75 post offices of Benjamin Franklin's time:

In one year the United States postal system

Handled one third of the world's letter mail.
Had 51,000 post offices.
Operated 45,000 rural routes.
Operated on 238,000 miles of railroad.
Made nearly 20,000,000,000 distributions and redistributions of mail.
Employed 300,000 men and women.
Had a yearly income of $600,000,000.
Had a yearly expense of $640,000,000.
Received an average of $5.28 for every person in the country.

It is hard to realize what a vast amount of mail is handled every day by the postal service. Day and night the postal workers

FIG. 203. This is the American two-cent postage map of the world. To all places in the shaded areas a two-cent stamp will carry an ounce letter. To all parts of the world left white on the map a five-cent stamp will deliver the letter. (Courtesy of the United States Post Office Department)

battle with the flood of letters and parcel-post packages. Thousands of expert distributors are required to sort this mail and start it along the right channel toward its destination.

The mails go into every country village and every mountain district, no matter how far away or how much the cost. If automobiles or airplanes serve better, then they must be used. If the mail can be distributed throughout the city more quickly by shooting it through underground tubes, then we must have underground tubes. The carrying of the mail is so important that the fast mail trains are given the right of way over all others. To hasten the delivery of mail some of the sorting is done as the train speeds on its way. From 1864, when this plan was first put into operation, to 1925, the length of the lines on which the railway post office was in use increased from 22,000 to 238,000 miles.

The table on page 314 shows a very interesting and important fact about the United States postal service. Although it is an immense business enterprise, it is not run for profit.

The air-mail service

On May 15, 1915, in the midst of the World War the United States air-mail service was started with the opening of the first line between Washington and New York City. Although it was regarded as an experiment, it was so successful that during the next year air-mail service was extended from New York to Cleveland and then on to Chicago. Less than a year later the service reached all the way across the continent from Boston to San Francisco. Branch lines were started connecting Minneapolis and St. Louis to Chicago. Year by year the mileage of this air-mail system is increasing. It is important to remember that a single plane can carry as many letters as a railroad mail-distributing car. At first the mail airplanes flew only in the daytime, but in 1921 night service was inaugurated as well. Flying both day and night, a plane can transport mail from the western coast to the eastern coast in 34 hours.

These mail planes are almost as regular in maintaining their schedules as are the railroads. They fly more than 95 per cent of the time, rain or shine, warm or cold. The air-mail service is as well planned as the railway-mail service. Like the latter, it has regular terminal points and repair and service stations. The main stations of the air-mail service are about 400 miles apart.

Between these principal terminal points, which are usually located in the large cities, smaller junction points are arranged at intervals of about 100 miles.

An interesting change has taken place recently in the ownership of the air lines. Until 1927 they were owned and operated by the United States Post Office Department. Since that date the air-mail lines have been turned over to private companies with which the government has contracts. So rapidly has the air-mail service grown that 1,500,000 pounds of mail were carried in 1927, the equivalent of approximately 60,000,000 letters.

Rapid transportation and the mail service, then, form some important ties that bind us together

This chapter has shown you that it took men a long while to devise an alphabet that they might express their thoughts to those far from them. You learned that rulers of earlier civilizations understood the necessity of keeping in touch with far-distant parts of their kingdoms. To meet their needs, regular post systems were established. The demand was always for more rapid and safer means of sending written messages. Not until the steam engine was perfected could a really rapid and sure means be found to transport the written word. Electric motors and gas engines, too, have recently aided in building up such a system of postal service as has never before been known. The railroad train, the street car, and the automobile help to deliver the morning paper, which brings news from every part of the country. The morning mail brings messages from relatives and friends far distant. We learn what they are doing, what they are thinking about, whether they are well, how their business thrives. We are nearer to the rest of the world now that air planes, railroad trains, automobiles, and ocean liners distribute letters, newspapers, and books containing news of far-away places quickly and cheaply.

Today, however, we are actually within *talking* distance of almost everyone in the United States. The world has "grown small" because of the miracle of *instantaneous* communication. To the study of that we turn in the next chapter.

INTERESTING READINGS FROM WHICH YOU CAN GET ADDITIONAL INFORMATION

Books

*Keir, Malcolm. The March of Commerce (Volume IV of The Pageant of America). Yale University Press, New Haven, 1927.

Chapter X (The Letter Post).

*Tappan, Eva March. Modern Triumphs (Volume XIV of The Children's Hour). Houghton Mifflin Company, Boston, 1916.

See the chapter entitled "On the Trail of the Red Letter." The author travels with his letter, carried by the post office, from New York to Mount Hope, Wisconsin. A story showing the many hands through which a letter passes.

Magazine Articles

"Grazing Tragedy with the Air Mail," *Literary Digest*, October 17, 1925, pp. 83–87.

*"Lighting the Night Air Mail," *Literary Digest*, July 31, 1926, pp. 18–19.

*"On the Trail of the Air Mail," *National Geographic Magazine*, January, 1926, pp. 1–61.

*"The Perils of Flying the Night Air Mail," *World's Work*, August, 1927, pp. 360–372.

CHAPTER XIX

THE DAY OF ELECTRICAL COMMUNICATION

On June 29, 1927, Commander Richard Byrd, with three companions, was flying over the middle of the Atlantic Ocean on his way from New York to Paris. Suddenly Byrd's radio received a

FIG. 204. This reminds us that by means of electrical communication the country and the city, the factory and the farm — all the parts of our country, both near and distant, have been tied closely together. (Courtesy of the American Telephone and Telegraph Company)

wireless message that Lieutenants Maitland and Hegenberger (who had left San Francisco on a Pacific flight at almost the same hour that Byrd had left New York on his Atlantic flight) had landed safely in Honolulu. Whereupon Byrd, from his airplane, wirelessed to New York a message of congratulation, which was immediately transmitted to the two aviators in Honolulu. Thus within a brief time messages were exchanged between points more than 6000 miles apart. In this episode each of the messages was transmitted almost instantly by wireless from one person to another in a distant place. Since that time even greater distances have been spanned, as you will learn later in the chapter.

Even this record of almost instantaneous communication is constantly being exceeded. Day by day improvements are being made in the ways of sending messages by wireless. Today explorers near the south pole, encamped in a snow-bound waste thousands of miles from the nearest settled community, listen to orchestras playing in American or European cities. People in ships on the high seas or in trains moving at express speed can at any moment be in communication with other people at points far distant from them. Little wonder that we speak of our times as the day of instantaneous communication.

Through all the ages men have striven for more rapid means of communication

The history of communication is filled with interesting examples of the way in which people have tried to communicate with each other instantaneously. Figure 205 reminds us that for

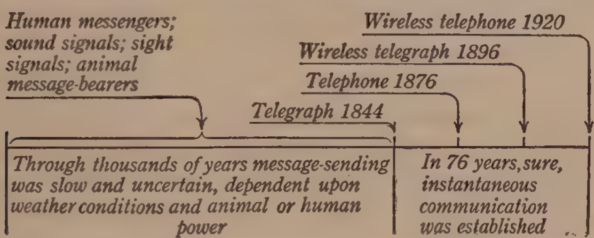

FIG. 205. This time line reminds us of the newness of electrical communication

thousands of years rapid long-distance communication depended upon the sending of signals. Men's need for rapid message-sending was so great that they tried everything they could think of — shouting through the air, whistling, sending up smoke signals.

At first people could communicate no farther than the sound of the voice would carry. They discovered that a whistle carries farther than a cry; so that was used. They learned that often one can see farther than he can hear; so some primitive peoples learned to send long-distance messages by smoke from fires. These sight signals and sound signals would carry only a few miles. So there was always that problem of distance. Furthermore, such signals were not instantaneous; that is, the receiver did not get

the message immediately from the sender. Sometimes the signals were received by one person who would relay the message to another. And of course such messages were not dependable, because they were affected by many conditions over which the sender had little or no control, such as fog, darkness, winds, lay of the land, and distance.

Nevertheless, many ingenious schemes were devised by men for sending signals. At night flaming beacons glowed through the darkness, and in the daytime dense clouds of smoke conveyed messages. It was impossible, of course, to send anything except prearranged messages; so codes were invented. For example, danger was sometimes signaled by breaking up the column of smoke rising from a fire into short puffs. Security was indicated by long puffs of smoke.

Frequently such prearranged messages were observed by enemies as well as by friends. At the battle of Marathon, for example, the Persians resorted to an interesting method of sending messages in their attempts to defeat the Greeks. On a mountain near the battlefield they set up a polished shield with which they could reflect the rays of the sun and so signal the Persian soldiers. When the Persian messengers brought the news that the city of Athens was left unprotected, the signal was flashed. Upon seeing it the Persians promptly returned to their ships and sailed to the city. They intended to capture Athens while it was unguarded. But the Greeks had also seen the signal and, guessing its meaning, they had marched back to Athens in time to save the city.

Many kinds of sound signals were also used. Figure 206 shows the use of signal drums in the Fiji Islands. By means of them the natives could send rather complicated messages. Such drums can be heard for miles in the jungle. In various parts of South America also sound-signaling is still used by the native peoples.

When Lange, the explorer, was in South America several years ago, his guide at one point set up a sound-signaling apparatus and sent this announcement: "A white man is arriving with us. He seems to have a good heart and to be of a good character." The reply was: "You are welcome provided you place your weapons in the bottom of the canoe."[1]

[1] For this and other factual material contained in this chapter indebtedness is acknowledged to the New York Telephone Company.

Another interesting example of sound-signaling is that of the shepherds in the Canary Islands. For centuries these people communicated by whistling to each other. They developed a code of musical notes so elaborate that they could carry on complete conversations over distances of three or four miles. The story is told of a landlord, an owner of farms in one of the islands, who secretly took lessons in whistling in order to keep tab on his tenants. On his next visit he heard his approach being heralded from hill to hill by whistle signals. Reading their messages, he discovered that instructions were being passed on to hide a cow here or a pig there, so that he could not claim them as rent.

Fig. 206. The boatlike objects in this picture are hollowed tree trunks with which the Fiji Islanders send their signals today. They are the same kinds of drums which their ancestors for centuries used to call the tribes together for feasts or for war. (Photograph from Ewing Galloway)

Indians of North America used smoke signals to communicate over long distances. They built smudge fires and sent smoke up into the air by alternately covering and uncovering them. They also sent up smoke clouds from flaming torches. The meaning of the smoke puffs and flames was understood by the receiver because a code of signals had been arranged beforehand. Each tribe had its own code. When General Frémont and his men first explored the forests of Upper California (about 1845), they noticed unusual columns of smoke rising in the air at a number of places. Later they learned that the Indians were warning each other of the presence of enemies in their country.

In the United States, even as late as 1800, long-distance signals were sent by such crude methods as wigwagging, shooting off guns, and ringing bells. Messages sent by these methods still depended upon sight and sound signals. Of these methods the

most complete long-distance conversations could be had by wig-wagging, such as our army and navy now use. Holding a flag in each hand, the signalers stood on hills or high towers as far away from each other as the eye could reach. The flags were held in various positions and moved in prearranged ways. Each position or movement meant a certain letter in the alphabet. In this way messages were spelled out. Of course this method was very slow for anything but short signals, and was not satisfactory on foggy days.

FIG. 207. American Indians sending long-distance messages to each other by smoke from a torch. (Courtesy of the Detroit Institute of Art)

The firing of cannon and the ringing of bells were sometimes used for sending signals. During the celebration at the opening of the Erie Canal, cannon were used to send word from Buffalo to New York City of the entrance of the first boat into the canal from Lake Erie. Men and cannon had been stationed at intervals along the way. The sound of the firing of the first cannon was the signal for the men at the next station to touch off the second cannon. The firing of the second was the signal for the men stationed at the third cannon to fire it, and so on to the end. It took about an hour and a half for the message to be sent from Buffalo to New York City.

These ways of communicating, however, were neither accurate nor rapid. For one thing they depended upon the weather. If there was a fog, signals could not be seen. If there was a storm they could not be heard. The sending of messages by such methods over long distances required considerable time. Signs and sounds are likely to be misunderstood. Human sight and hearing can never be as accurate at recording impressions as a machine.

After 1800 came electrical communication: the telegraph, the telephone, and the wireless

We have already studied how scientists learned to make electricity and utilize it as a source of power with which to run machines. At the same time other scientists were discovering how to use electricity to carry signals over wires and through the air. The telegraph, the telephone, and finally the wireless, upon which we depend so much today, were the result of a revolution in communication that developed at the same time as the revolution in transportation.

1. Samuel F. B. Morse invents the First Electrical Telegraph (1844)

In 1832 Samuel F. B. Morse, a portrait-painter, was returning on a steamer from Europe. On the ship he met a fellow passenger who, like himself, had been studying in Europe. But while Morse had been studying painting the other had been studying electricity. This fellow passenger had with him an electromagnet, which Morse examined with great interest, for he had given some time to studying electricity while a student at Yale. Immediately he was struck with a new idea; namely, that electric signals could be sent long distances over wires by means of an electromagnet. He was so convinced of the possibility of this that he said to the captain of the ship: "If you should learn of the invention of a [practicable] telegraph one of these days, remember that the real discovery was made on board your ship." From that time on he gave almost all his time to the attempt to invent a practicable telegraph. The difficulties which he confronted were very great. He was poor; he had little mechanical ability or scientific training. His ability and experience as an artist, however, secured for him an appointment as professor of art in the University of the City of New York, which gave him a place in which to carry on his work. There he was assisted by one of the professors of science. For three years he worked at his invention.

On the completion of his first experimental telegraph he made public demonstrations of it and sought help from wealthy people

and from Congress. Eleven years passed, when finally Morse, having exhausted every means of obtaining help from individuals, secured aid from Congress, which passed a bill appropriating the sum of $30,000 for a trial telegraph line. An experimental line was set up from Washington to Baltimore. Wires were strung on crude poles, the necks of bottles being used as insulators. Finally, on May 24, 1844, the new experimental line was completed, and Morse telegraphed the words "What hath God wrought!" from the Capitol at Washington to his partner and assistant, Theodore N. Vail, at Baltimore. Vail telegraphed the words back to Morse.

The telegraph was a sound-sending instrument. It conveyed messages by a code of signals. As a result of past study and experimentation, sending and receiving instruments had been devised. The tap of a key at one end of a wire through which an electric current was passing caused a small movable bar at the other end to make a tiny click. A code alphabet was made up consisting of long and short clicks, which stood for letters. The telegraph operator, using this code of clicks, could tap out a message, which was translated into words and recorded at the other end of the wire, even hundreds of miles distant.

Since Morse's time many improvements have been made in the telegraph. For example, by the instrument which he invented only one message could be sent at a time over a single wire. A few years later, improvements made it possible to send two messages at the same time. Recently Thomas A. Edison invented a system by which eight messages can be sent over the same wire at the same time.

Although people were at first slow to adopt the new way of sending messages, it was not long before railroads, other big businesses, and private individuals began to use it. In less than ten years most of the railroads had adopted the telegraph for transmitting orders to employees and for managing their trains. What a difference it brought in the operation of the railroads! Through its use trains could be controlled from central offices. Because of it they ran much more regularly and much more safely. The telegraph far surpassed the railroad as a message-carrier. No longer did people have to send their important messages by the slow

postal service, with its dependence upon railroads and postmen. Brief messages could be flashed to them almost immediately by telegraph. In 1861 the Atlantic and the Pacific were linked by electrical communication through the completion of the first transcontinental telegraph line. At that date more than 50,000 miles of telegraph wire connected the important cities of the country with one another.

2. Cyrus W. Field laid the First Submarine Telegraph (1858)

So as a result of Morse's invention the cities of each continent were linked together, but the continents were still an ocean voyage apart. A message could be sent quickly from Washington to New

Fig. 208. Testing the first cable at the shore end

York or from Paris to Berlin, but one from New York to London had to wait upon ocean steamships. Wires had not been laid under the ocean.

Shortly after the successful completion of his invention Morse had proved that wires could carry a message in water as well as in air, provided the wires were inclosed in a cable. Even before the

Washington and Baltimore telegraph line had been constructed he had actually run a cable carrying telegraph wires through the waters of New York Bay. In 1850 a cable had been laid across the English Channel, joining England to the mainland of Europe. Shortly after, another cable was laid to connect England with Ireland. At the same time people were proposing to connect New York and Newfoundland, because Newfoundland is closer to Europe than New York. Such a line would have shortened the time required to send messages to Europe. Others proposed to connect Europe and America by building a telegraph line across Russia, Siberia, under Bering Strait, and southeast across North America to the Atlantic coast.

"Why not lay a cable containing telegraph wires straight across the Atlantic Ocean?" asked Cyrus W. Field, a successful New York business man. Field had retired from business at the age of thirty-four with a fortune of $100,000. For years he devoted himself to the completion of this cable-laying project. After great difficulties, during which his own fortune was exhausted, he turned to others for aid and finally secured help from the British and American governments. In 1857 and 1858 his company tried four times to lay a continuous cable between Europe and North America. At last, on August 5, 1858, he was able to send the following telegram:

Trinity Bay, Newfoundland
August 5, 1858

Mrs. Cyrus W. Field
84 W. 21st St.
New York

Arrived here yesterday. All well. The Atlantic telegraph cable successfully laid. Please telegraph me here immediately.

Cyrus W. Field

There were great celebrations on both sides of the Atlantic. The members of the Atlantic Telegraph Company were welcomed as heroes, and dinners and receptions were given them. A sample of the posters displayed in the United States is shown on page 327.

But the difficulties were not yet over. Other accidents occurred, and the company had to start all over again. Field did not give up

his determination to connect Europe and America by cable. He crossed the ocean 37 times, forming one company after another,

Lightning
caught and tamed by
FRANKLIN,
taught to read and write and go on errands
by
MORSE,
started in foreign trade by
FIELD, COOPER & CO.,
with
JOHNNY BULL
and
BROTHER JONATHAN
as
special partners

leasing ocean ships, and spending huge sums of money. At last in 1866 he succeeded in laying a practicable cable, and since that time the United States and Europe have always been connected by submarine wires.

The importance of the cable to the great nations of the world

Only 22 years had passed since Morse had made possible swift electrical communication. Now American and English business men had shown how to use it in tying continents together. Not only could the communities of a single country keep in constant and almost instantaneous communication with each other, but countries and even continents could do the same. From the date of Field's success each of the chief European countries made use of undersea telegraphic communication. Great Britain, the United States, France, and Germany, the four greatest industrial countries, took the lead in this work. The first cables between Europe and North America were owned by British companies.

It was not long before American companies were formed which laid cables to Europe, to Mexico, and to Central and South America.

French and German companies joined their countries to North America. Submarine cables were laid from France and other western countries directly to South America. Lines were built through the Mediterranean. A line was constructed which joined western Europe and the southern end of Africa. Other lines joined Africa with various parts of Asia. Figure 209 shows that the largest number of cables have been laid between western Europe and the eastern coast of the United States. The next largest number join Great Britain and western Europe with the countries bordering on

Fig. 209. This map shows where the principal submarine telegraph cables of the world are now laid. Compare it with figure 250. (Courtesy of the *Journal of the American Institute of Electrical Engineering*)

the Mediterranean Sea. The third largest number join South America to the United States and to western Europe. Today there are more than 260,000 miles of telegraphic cable. If you will compare figure 209 with figure 251, you will note an important similarity. Undersea telegraphic communication is most completely established between the regions that are engaged in the largest amount of trade. After you have studied Chapter XXVII you will have information which will enable you to see the importance of this similarity.

Why have the chief countries of the world been so eager to establish undersea telegraph lines? There are three important reasons: the gain to trade, to government, and to the gathering of news.

First, swift communication is necessary for trade. The business men of each of the leading countries buy from and sell to those of nearly all other countries. This can be done efficiently only by accurate and rapid communication. By means of the telegraph, inquiries can be made and sales agreed upon within a day between companies located 10,000 miles away from each other. Lacking such communication, weeks would be required. Seeing this clearly, business men have been willing to spend large sums of money to build submarine lines.

Second, each of the leading countries of the world owns land and governs people located thousands of miles away from the home country. For example, Great Britian controls India, Australia, Canada, and other distant regions, and France governs peoples in Africa and Asia. The United States governs the Philippine Islands, the Hawaiian Islands, Porto Rico, and Alaska. To some extent all other countries have the same need for communication across the oceans. Each of these governments recognizes the value of the submarine telegraph in sending orders to its officials in distant regions both in times of peace and in times of war.

Third, the submarine telegraph makes possible the swift gathering and publication of news from all over the world. By means of it newspapers in thousands of communities can print within a few hours of their happening the story of events that have taken place on the other side of the earth.

3. Words over Wires for the First Time (1876): Alexander Graham Bell invents the First Telephone

The telegraph transmitted electrical impulses which made sounds or clicks at the other end of wires. It could not transmit words directly. Thirty-two years after its invention the telephone carried the human voice itself over wires.

In the year 1875, when the telegraph and the Atlantic cable were among the most wonderful things in the world, a young professor in Boston University, Alexander Graham Bell, was busy in the loft of a shop that stood in one of the narrow streets of Boston. He was working on a queer machine, a sort of crude harmonica with a clock spring, a reed, a magnet, and a wire.

Fig. 210. This is Alexander Graham Bell, and the attic in which he completed the invention of the first telephone in 1876. (Courtesy of the State Street Trust Company, Boston)

He had succeeded in making it convey a sound along the wire, which connected it with another queer-looking machine in the next room. This was a wonderful achievement. It was the first time in the history of the world that a complete sound had been *carried* along a wire. For 40 long weeks of experiment the instrument would only gasp and make noises. It would not carry words or transmit a sentence clearly. Its secret was only partly understood. Then came the great day, March 10, 1876, when *it talked*. On that day Thomas A. Watson, Mr. Bell's assistant, had run a wire from the workshop in the attic down two flights of stairs. Mr. Bell was at his instrument in the attic. He called into the crude transmitter. Watson, two flights below, had the receiver at his ear. "Mr. Watson," it said distinctly,

Fig. 211. Model of Bell's first telephone. (Courtesy of the United States National Museum)

"please come here. I want you." Watson dropped the receiver and, wild with joy, rushed up the stairs to tell Bell the glad news. "I can hear you!" he shouted breathlessly. "I can hear the words!"

Bell had difficulty in persuading people that the telephone was useful

Even after Bell had made the telephone work, it was hard to get people interested in it. Almost no one thought it would have any practical value. Many people said it was a humbug, a hoax, or a trick. "Of course, it is impossible to talk over a wire," they declared. Others said, "It is only a scientific toy, an interesting experiment; but it can never be of any use."

Bell had to face the same opposition and ridicule with which many other great inventors have had to contend. Elias Howe's first sewing machine was destroyed by a mob of people. McCormick's reaper was laughed at and called names. For years Congress considered Samuel Morse and his telegraph nothing but a nuisance. Field too had met with the same difficulty. Later Westinghouse, inventor of the air brake, was called a fool for trying to stop a railroad train with "wind."

As Bell had first worked on his invention in Salem, one editor displayed the headline "Salem Witchcraft." The *New York Herald* said, "The effect is weird and almost supernatural." The *Providence Press* said, "It is hard to resist the notion that the powers of darkness are somehow in league with it." Only 50 years ago!

Bell knew that people would not use the telephone until they were made to understand what it would do. So he and Watson went about giving lectures and demonstrations. As he was a student and teacher of public speaking, his lectures became very popular. A Japanese student was learning from Mr. Bell the correct pronunciation of English. He startled Mr. Bell one day with the question, "Will the telephone speak Japanese?" He seemed surprised when Mr. Bell assured him that it would. He brought two Japanese friends and, after trying it out, decided that the telephone could be used even in Japan. Bell persuaded

two of the Japanese gentlemen to take part in one of his public demonstrations to convince people that the telephone would speak any language! At one of his lectures a band played "The Star-Spangled Banner" in Boston, and this was heard by an audience in Providence, Rhode Island.

The improvements of the telephone

We cannot tell the whole story of the telephone. The struggle of the Bell Telephone Company to gain recognition, to get on its feet financially, and to improve the telephone was long and hard.

FIG. 212. This illustrates how a modern switchboard is operated. Note the supervisors standing behind the operators. (Courtesy of the American Telephone and Telegraph Company)

Improvement came only as the result of many inventions. These included the devising of the switchboards to connect many telephones, the improvement of wires, the making of cables to carry them underground, and the general perfecting of all parts of the telephone.

Bell's first telephone lines were very simple, just like clotheslines stretched between two points. Every little line stood by itself, with one instrument at each end of the wire. There were

no switchboards, exchanges, or operators. The man at a telephone at one end of a wire could talk with the man at the other end of that wire, but not with a man on any other wire. Bell had to work out a system so that any telephone could be connected with any other. Today three telephones or 300 or almost any number can be easily and quickly connected through the switchboard. This telephone switchboard is a complicated affair, built of millions of finely adjusted parts. To plan, make, and install such a switchboard sometimes takes two years. When you think of the number of telephones connected with it you can appreciate what a wonderful thing it is. So elaborate have some of these switchboards become that in a single building like the Hudson Terminal Building, in New York City, there are more telephones than there are in some European cities and more than in the two countries of Greece and Bulgaria combined.

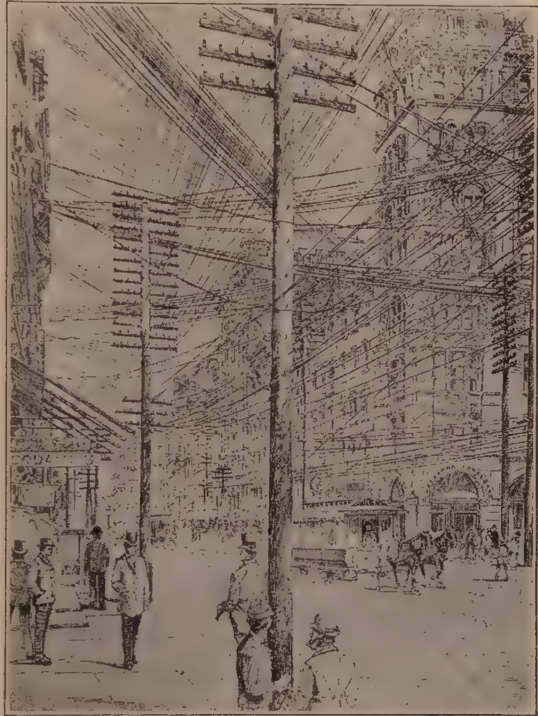

FIG. 213. Compare the artist's conception of this New York street in 1890 with the same street in 1916 (shown in figure 214). (Courtesy of the American Telephone and Telegraph Company)

At one time all the wires connecting switchboards and telephones were carried on poles aboveground. This was satisfactory in the rural districts, where there were fewer telephones, and in many places these wires are still carried that way. But in the city, as the use of the telephone increased rapidly, the streets soon became black with wires. Larger poles had to be used, and

soon in some cities they rose to a height of 80 feet. Finally the highest of all pole lines was built along West Street, New York, every pole a towering Norway pine, with its top 90 feet above the roadway and carrying 30 cross-arms and 300 wires. These were dangerous, unsightly, and difficult to keep in operation. So it was decided to put the wires underground, and after many experiments the method by which telephone cables are now made was discovered. The copper wires were wrapped in loose paper and bound together in a cable covered with lead. Perhaps you may have seen these big cables being laid in city streets. They are unwound from great drums around which they have been coiled like thread around a spool. In spite of their great weight they are easily handled in this manner. As early as 1896 there were 200,000 miles of wires snugly wrapped and lying in leaden cables beneath the streets of our larger cities. Today there are more than a hundred times as many miles of wire.

Fig. 214. By 1916 telephone wires were being laid underground. Compare this picture with that of figure 213. (Courtesy of the American Telephone and Telegraph Company)

Other improvements were worked out as the use of the telephone increased. For example, instruments were invented to detect breaks in wires. These breaks caused telephones to get out of order. If the difficulty is not in the telephone or in the switchboard, it must be somewhere in the wires underground. There

FIG. 215. This illustrates how 2424 wires are wound together in one underground cable. In 1925 there were 28,000,000 miles of wire beneath the streets of American cities and towns. (Courtesy of the Western Electric Company)

are now delicate electrical instruments which locate the break almost exactly, enabling repair men to go to the right spot and to take up and repair the cable.

One of the most important recent improvements in telephone service is the substitution of automatic central switchboards for those attended by human operators. The idea of the automatic telephone is not new. Only three years after Bell's first telephone was made, men tried to build a telephone system which would make the connections automatically. Since that time many inventors have worked on the problem, and more than one automatic system has been devised. Automatic telephones have been used in some cities for several years. The problem, however, of developing an automatic system for a large city such as New York is a tremendous and difficult one. More than 1,000,000 subscribers must be able to reach any one of the others without any human aid. Scores of central offices must be connected. The system must be put into operation gradually, without disturbing the service over the old lines. It seems impossible that such a system could be installed, but it is actually being done, and soon switchboards like that shown in figure 212 will be used no more.

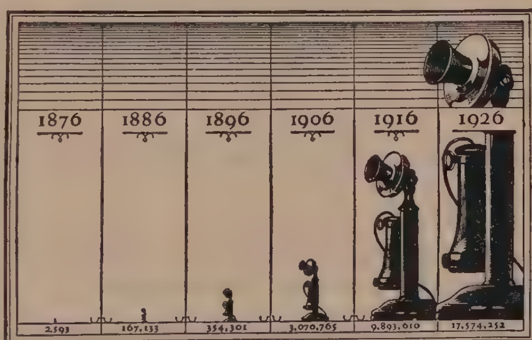

FIG. 216. This illustrates the increase in the number of telephones in 50 years. (Courtesy of the American Telephone and Telegraph Company)

Before 1876 there was not a telephone in the United States. By the end of that year there were nearly 2600 telephones in operation; fifty years later there were more than 17,000,000! (See Figure 216.) In the earlier chapters of this book you have learned that in this same half-century the United States was becoming a leading industrial country. In every one of its great industries growth was rapid and nation-wide. This was the period in which most of the great railroad systems were built, in which production of coal, of iron and oil, and of cloth, shoes, and other manufactured goods increased at startling rates. Correspondingly, it was the period in which electrical communication spread all over our country. Note the chief steps in the development of telephone conversation:

1876 First sentence transmitted by telephone.
1877 First telephone exchange.
1881 First conversation by underground cable, a quarter of a mile.
1916 Speech first transmitted by wireless telephone from Arlington, Virginia, across the continent to San Francisco, over the Pacific to the Hawaiian Islands, and across the Atlantic to Paris.
1921 Conversation between Havana, Cuba, and Catalina Island, California, by submarine cable, overhead and underground lines, and wireless telephone.
1922 Conversation between telephones in cities of the United States and on a ship 400 miles at sea.
1923 Demonstration of transatlantic wireless telephone between New York and London.
1924 First public demonstration of transmitting pictures over telephone lines.

The distance over which telephone conversation could be carried on increased correspondingly:

1876 First complete sentence transmitted by telephone.
First conversation from Boston to Cambridge, two miles.
1884 Boston to New York, 235 miles.
1892 New York to Chicago, 900 miles.
1911 New York to Denver, 2100 miles.
1915 Boston to San Francisco, 2650 miles.
1921 Havana, Cuba, to Catalina Island, California, 5500 miles.
1927 London, England, to San Francisco, 7291 miles.

4. The Wireless Telegraph and Telephone

Wonderful as were the inventions by which men could send messages over wires, still more marvelous ones were to follow. No sooner had the telegraph and telephone come into widespread use than men discovered how to send messages through space *without* wires. An unusual illustration of wireless communication is provided by an anecdote that recently appeared in the newspapers. The manager of a radio station was listening to radio messages from Commander Richard Byrd, near the south pole. He had been in telephone communication with the office of one of our metropolitan newspapers a few miles away. Accidentally he had left the telephone receiver off its hook, with the result that the office was unable to ring him. Knowing that he was listening to Byrd, his associates in the office wirelessed to Commander Byrd to broadcast a message telling him to hang up his receiver. This was done immediately. He heard this message from Byrd and again established telephone communication with the newspaper office. In this anecdote, therefore, we have a good example of one of the latest developments in swift, long-distance communication. In a few minutes three messages, one by wireless telephone, another by wireless telegraph, and a third by ordinary telephone, had traveled over 21,000 miles!

To tell the whole story of the development of this wonderful wireless communication, we should have to go back many years and trace the increase in our knowledge of electricity. Credit for this knowledge could not be given to any single person, for it was made possible through the efforts of many men of science. In brief, however, it was discovered that when an electrical current jumps a short gap, it not only produces a spark, but it also sets up invisible waves which travel out in all directions with tremendous speed.

Perhaps it will help you to understand how these waves convey messages if you think of other well-known examples of wave motion. When we drop a stone in a quiet pool, we see water waves radiate out in all directions. When we strike a bell or make any other noise, sound waves are produced in the air which go out in all directions from the bell. We cannot see these waves

however. In a similar way, waves of electricity go out in all directions from the spark gap. Water waves move very slowly; sound waves, more rapidly; but electric waves move very rapidly, indeed many thousands of miles per second. These electric waves not only move very swiftly, but they are also able to pass through most solid substances.

Marconi invented the wireless telegraph, 1895

No practical use was made of these waves until 1895. In that year Guglielmo Marconi, a young man of twenty-two, succeeded in using them to telegraph messages over a distance of several hundred feet without the use of wires. That was the first wireless telegraph. Within a year Marconi had so far improved his apparatus that he was sending wireless telegrams over a distance of ten miles. Three years later, 1898, he wirelessed a message across the English Channel — 24 miles. With each improvement he dreamed of sending wireless messages across the Atlantic Ocean. Steadily he succeeded in reaching more and more distant points.

Finally in December, 1901, a very powerful sending set was completed and erected in England, ready for the great transatlantic test. The test was to consist of sending the letter "S" by means of the Morse code across the ocean at certain times each day. Marconi, who was to receive the messages, waited in a little shack in Newfoundland, off the coast of Canada. The time for the signals drew near, the time toward which Marconi had worked and planned. At last click-click-click in the receiver! Marconi asked his assistant to listen. All was quiet; then distinctly it came from across the Atlantic—three clicks, again the letter "S."

Once again North America and Europe were brought closer together. This time the tie that connected them was more than a slender cable under the sea — it was unseen waves traveling over both land and sea through ordinary air. This new tie was not to be stopped by distance, by mountain heights, or by bodies of water. It was not obliged to follow certain routes only, as were the earlier inventions — telegraph, cable, and telephone. At last man had controlled these waves, and using them he again had spanned the great barrier of space.

Wireless stations were built along the coasts of Europe and America, and messages began to flash back and forth between the continents. Soon ships too began to be equipped with wireless apparatus, and all sorts of messages were sent as men discovered new uses to which this invention could be put. Passengers in mid-Atlantic could now be in constant touch with people on both sides of the ocean. Ship's captains could be kept informed of the weather conditions they were liable to meet, and changes of sailing orders could be given them instantly.

But the great importance of the wireless telegraph to people on the American side of the Atlantic was not fully appreciated until this ocean had been bridged by the new device for nearly eight years. Early one morning in January, 1909, the operator in charge of the Nantucket (Massachusetts) wireless station heard a "distress" signal from the steamship *Republic*. This ship was a large transatlantic passenger boat belonging to a steamship line which provides transportation for great numbers of American travelers. The wireless operator on board the *Republic* informed the shore station that his ship had collided with a cargo ship and both needed help. Within five minutes after the message had been received, the operator at Nantucket had wirelessed other ships in the neighborhood and five of them were steaming rapidly toward the scene of the accident. The prompt rescue of those aboard the disabled vessels did a great deal to enlist the interest of our people — and of people throughout the world — in the wireless. From then on the wireless telegraph took its place as an important addition to our means for instantaneous communication. Today, because of it, ocean travel is much safer. No ship at sea need ever be out of communication with other ships or with stations on shore. News from the four corners of the world is broadcast to passengers thousands of miles at sea.

5. The Wireless Telephone, 1916

Fifteen years after the first wireless telegram was sent from Europe to North America, spoken words were broadcast through the air from one continent to the other. Each invention had helped to produce more inventions. The knowledge that had

accumulated in the invention of the telegraph, the telephone, and the wireless telegraph made it possible to invent an apparatus that would send words and other sounds through the air. The result was the radio, or wireless telephone. Just as Marconi had learned to use electromagnetic waves to send telegraphic messages, so other scientists now used these same waves to send

FIG. 217. This shows President Gifford, of the American Telephone and Telegraph Company, speaking from New York to Sir Evelyn Murray in London, at the opening of the first transatlantic telephone service on January 7, 1927. Mr. Gifford is the man in the middle holding the telephone transmitter. Grouped about him are the directors and officials of the company. (Courtesy of the American Telephone and Telegraph Company)

telephone messages. In 1927 officials of the American Telephone and Telegraph Company talked across the Atlantic to officials of British companies.

"'Good afternoon,' said a pleasant British voice in the receiver at my ear.

"'Good morning,' I replied.

"That sounds wrong, but it is absolutely right, for I, sitting in a long-distance telephone booth in New York City, was speaking with a man in London. It was two o'clock in the afternoon for him but only nine o'clock in the morning for me.

"My voice reached him over telephone wires 70 miles to a radio transmitting station at Rocky Point, Long Island, thence

by radio 3300 miles to a receiving station at Broughton, England, and then over telephone wires 70 miles to London."

At 3.30 in the afternoon in London, in the course of the first radio telephone conversation over the Atlantic, when Big Ben chimed from the Houses of Parliament, all the windows were opened, and the New York listeners were asked if they heard the chimes.

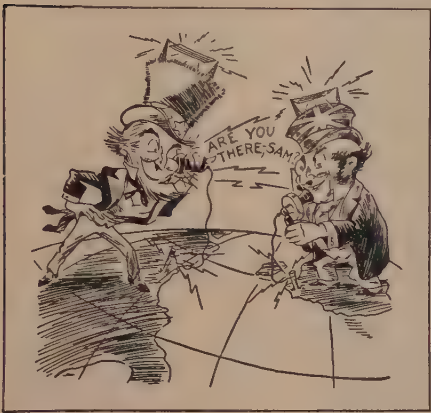

FIG. 218. Not so far across as it used to be. (Courtesy of the *Cleveland Plain Dealer*)

"We heard them very well indeed," flashed back the reply.

Forty long years of hard work on the part of many scientists and inventors were required to span the Atlantic by wireless telephone.

With transcontinental telephone service on railroad trains moving at high speed and on airplanes 10,000 feet in the air over the Atlantic, and with transatlantic wireless telephone service, it will not be long before a telephone will connect anyone with anyone else, any time, anywhere.

FIG. 219. A "wrong number" in 1940. (Courtesy of the *Detroit News*)

Today we have two kinds of wireless telephone—a "two-way" telephone (like that over which Mr. Gifford spoke to London as shown in figure 217), and the "one-way" telephone, or radio, with which you are more familiar. With the ordinary radio one cannot send messages, he can merely listen to them; he *receives* but cannot *send*. This is the form of radio that is transforming life in all the industrial countries of the world. The radio connects the farm with the city. The farmer

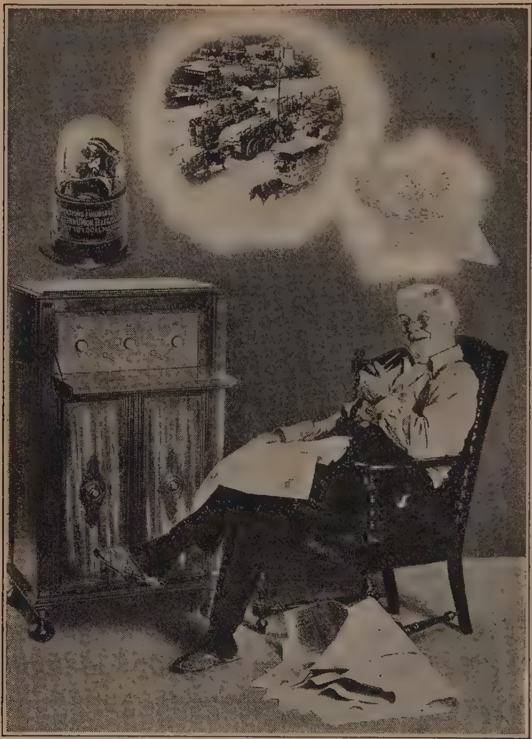

FIG. 220. Because of the radio the farmer is in instantaneous communication with the outside world. He gets market reports, weather reports, information of many types, which help him in his work as well as entertain him in his leisure. (Courtesy of the Western Union Telegraph Company)

sitting at home after the day's work, many miles from the city, hears the latest market prices on grain and knows when it will pay him to ship his crop to the dealer. The radio connects lonely explorers in arctic regions with centers of civilization. The radio tells us the correct time, or the weather predictions for the following day. Tuning in first on one sending station and then on another, we can listen to the radio at any time of the day. Music of every description, news, entertaining programs, scores of ball games from all over the country, cookery receipts, and helpful information of all kinds enter our home. The radio makes each one of us a part of a great world audience.

6. Eyes in Far Places! Pictures by Wire and by Wireless!

Not long after inventors learned to send sounds over great distances, they discovered a way of sending pictures rapidly from place to place "by means of these invisible waves."

In 1924 the first "telephotograph" was sent over a telegraph wire. In 1927 a photograph of Lindbergh with Ambassador Herrick greeting Paris crowds was transmitted by telegraph

cable from Paris to New York, a distance of over 3000 miles. A few hours later this photograph appeared in New York newspapers. Startling? It would have taken a steamship five or six days to carry the photograph from France to the United States.

Many newspapers now use the telephotograph method for sending pictures of important events almost instantly to many far parts of the United States. Moreover, this service is available to anyone. For a relatively small cost you can have your photograph sent within a short time to a friend who is many miles away.

Scientists were not content with sending a photograph by wire. They finally devised a way of sending a photograph over great distances without wires. Again thinking men conquered distance.

Moving pictures sent by wires? Impossible! Not at all. Close upon the news item which announced the successful spanning of the Atlantic by wireless telephone, came the announcement of the invention of *television.*

This new device has not yet become practical, but long ago the telephone, the telegraph, the cable, and the wireless were not considered practical. So one day television may be in common use. By television one can not only hear another's voice but can also see pictures of him as he speaks.

Television transmits at the same moment the voice and the picture of the person speaking. In the first public demonstration the apparatus sent pictures of Herbert Hoover, then Secretary of Commerce, by wire from Washington to New York City, a distance of more than 200 miles, at the rate of eighteen images a second. Mr. Walter Gifford was at the other end of the wire, "looking Mr. Hoover in the eye" as he talked with him.

Not only were moving pictures sent by wire, but later experiments showed that they could be sent successfully without the use of wires. A radio program such as one hears over the radio any day was broadcast, and pictures of the performers were transferred to a screen in a distant studio while their voices could be plainly heard. It was almost like having the performers actually in the room. This unusual method of communication is called *radio television.*

This television experiment is another example of the way in which scientific investigation is used today. Each of our largest

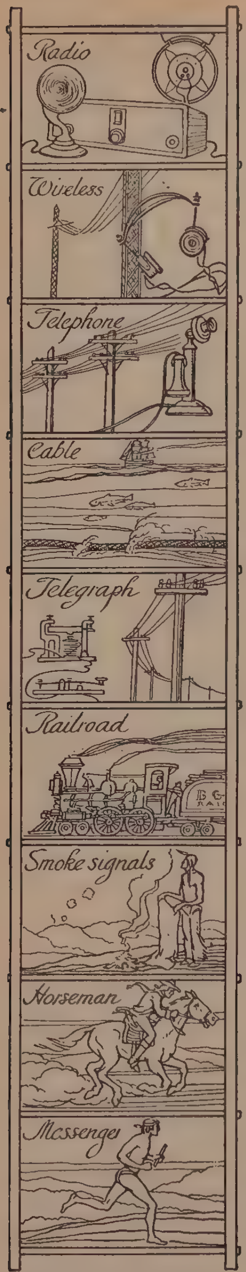

Fig. 221. Evolution of communication

electrical corporations employs many inventors and scientists. These men "have produced a long list of additions to the telephonic art," said Herbert Hoover to his New York audience in referring to television, "but no one of them more dramatic or more impressive than this."

Great is the speed with which science moves! Only a short time ago many of these inventions were announced as *possible* developments. Almost immediately scientists made these inventions *practicable.* Today, therefore, news of important events happening in Europe is being transmitted almost instantly to our leading metropolitan newspapers, together with photographs of the people and the places concerned.

Summing up our Study of Transportation and Communication

In this and the previous six chapters we have studied the chief ties that bind together the people of the modern world. We have seen how rapidly these ties have multiplied, bringing the four corners of the United States close together and connecting us by rapid means of communication and transportation even with the most remote countries of the earth. Today our whole country is like a big community. We receive news from the nation's capital, Washington, D.C., as readily as we do from our town councils. Swift and efficient transportation and communication are so much a part of our everyday life that it is difficult for us to realize the extent to which our new civilization depends upon them. Furthermore, the indus-

trial revolution in transportation and communication, like that in manufacturing, is going on today more rapidly than ever. Even as we write comes the announcement that trains can be started and stopped by radio; that power plants can be automatically controlled by trains approaching or leaving them!

1. Rapid highway, waterway, and railroad service carries people, goods, and messages across the continent. The government postal service uses these means of swift transportation to carry correspondence, newspapers, magazines, books, and parcels to every town in the country.

2. Airplanes transport people and messages even faster than our swiftest locomotives.

3. Wires flash almost instantaneous messages back and forth across the land and under the seas. The telegraph and the telephone bring people together more quickly than can the fastest air mail.

4. The wireless telegraph and telephone exceed even wire communication in swiftness. By means of them the most remote points of the earth maintain close communication. By radio, with a simple turn of the hand we become neighbors of our distant countrymen.

5. And by means of submarine cables and the wireless we become neighbors of the inhabitants of other continents. The world is, indeed, becoming smaller every day.

Of what importance are transportation and communication in the modern world? They are necessary to the many activities of the American people. Indeed, we could not have had machine-manufacturing without world-wide and rapid transportation and communication. Factories and cities and all that belongs to the age of machines are dependent upon uninterrupted transportation and communication. Our high standard of living, which means so many comforts for most of us in the United States, could not have been brought about without them. Finally, instantaneous communication has revealed its importance in no way more effectively than in the manner in which it has spread ideas over the whole world. Today an important new invention announced in one country is known almost immediately in nearly every region of the earth.

But most of all it is important to remember that the inventions that have brought the revolution in transportation and communication are examples of what men have been enabled to do by means of scientific knowledge. In the past century people, curious about the world around them, studied it and experimented with it. Some of them discovered wonderful things — new ways of working, new ways of making things, new ways of moving things, and new ways of communicating with each other. This has been possible only because they have learned new ways of thinking about things — that is, because of the growth of modern science. And science has brought about as wonderful a revolution in transportation and communication as it has in the making of power and in the manufacturing of goods.

INTERESTING READINGS FROM WHICH YOU CAN GET ADDITIONAL INFORMATION

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*Bridges, T. C. The Young Folk's Book of Invention. Little, Brown & Company, Boston, 1926.

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UNIT VI

THE AMERICAN PEOPLE AND THEIR WORK

INTRODUCTION TO THE FURTHER STUDY OF THE AMERICAN PEOPLE

To this point, in this book, we have been studying the chief causes of the high standard of living in the United States. We have illustrated three of them: first, our location in a stimulating and productive climate; second, our vast size and great natural wealth in soil, coal, oil, iron, and other resources; third, the many ways in which scientific knowledge has been applied in producing vast amounts of coal, oil, and other natural resources, and of manufactured goods, as well as in developing swift and efficient means of transportation and communication.

These three factors help to account for the comfort in which the people of the United States live today, but they do not account for it completely. There is a fourth factor, which we must now study more carefully than we did in Chapter V; namely, a large population composed of people of many races and nationalities, with many different interests and kinds of ability.

At this point, therefore, we shall consider more thoroughly the way in which our country was formed by the coming of immigrants from many lands. It is people rather than engines and machines that we shall study in the next two chapters. The central theme of Chapter XX will be the chief racial and national groups that make up the American nation — where these people came from, when and why they came, where they settled, and what kinds of work they did.

We shall then be prepared to understand how the work of a vast country like ours is successfully carried on. That will be the theme of Chapter XXI.

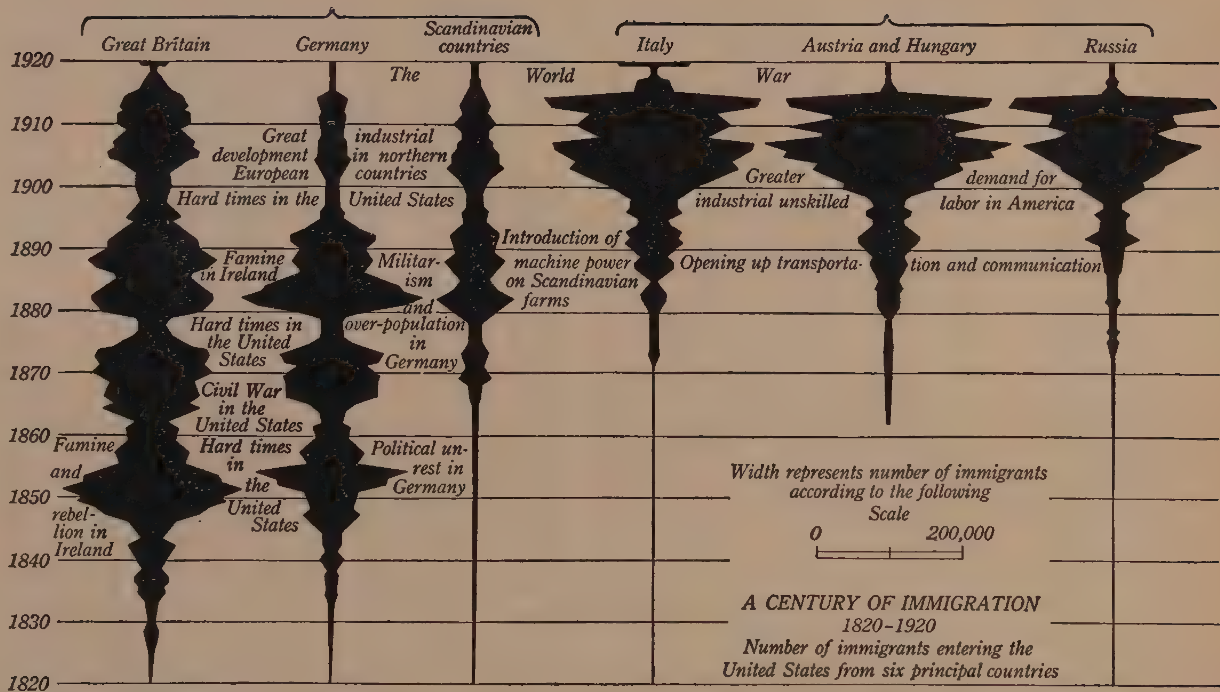

FIG. 222. This graph shows important national groups which have migrated to the United States between 1820 and 1920 and some of the reasons for their coming

CHAPTER XX

THE UNITED STATES HAS BEEN PEOPLED BY IMMIGRANTS

The Immigrant Speaks

"I am the immigrant.

"Since the dawn of creation my restless feet have beaten new paths across the earth.

"My uneasy bark has tossed on all seas.

"My wandering was born of the craving for more liberty and a better wage for the sweat of my face.

"I looked toward the United States with eager eyes kindled by the fire of ambition and heart quickened with newborn hope.

"I approached its gates with great expectation.

"I entered in with fine hope.

"I have shouldered my burden as the American man-of-all-work.

"My children shall be your children, and your land shall be my land, because my sweat and my blood will cement the foundations of the America of Tomorrow."[1]

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Fig. 223. The immigrant entering his new homeland

The United States was settled chiefly by Immigrants from Europe

From the first landing of the English Pilgrims to the present day the immigrant has come here to live, with "eager eyes kindled by the fire of ambition and heart quickened with newborn hope." For three centuries this land which we call America has been

[1] Adapted from *The Survey*, May 25, 1918, p. 214.

peopled by immigrants. The courageous Englishmen who settled Virginia, Massachusetts, and the other colonies were immigrants into the land of the Indian, as were other Europeans who came here in the last century. Indeed, the ancestors of all of us were immigrants.

During the first 150 years, from the landing of the Pilgrims to the Revolutionary War, the colonies were settled mainly by people from the British Isles. Most of the people spoke English and lived according to English customs. They were ruled by governors sent out by the English king. They built houses much like those they had had in England. They dressed, acted, and thought much like Englishmen. Their ways of doing business were English. Their customs and their laws were taken from English models.

Then came the Revolutionary War and, after it, the joining together of the thirteen colonies into the first thirteen states of the United States. Then came the great westward movement and the settlement of the land between the Appalachian Mountains and the Pacific Ocean. Most of the first pioneers to push westward into the Ohio and Mississippi valleys were descendants of British immigrants. Indeed, until 1820 very few immigrants came from countries other than England, Ireland, and Scotland. From then on to the present time, however, most of the immigrants who have peopled the United States have come from other countries than the British Isles.

In 1790, when the people of the United States were counted in the first national census, 91 per cent of them were descendants of British ancestors, and nine tenths of these British were English (see figure 41, Chapter V).

British ways of living and thinking were so firmly established that they have determined to the present time not only the language of the people of the United States but also many of the laws and customs. As you study the history of how immigrants from other countries came here to live, remember that they too gradually learned to speak English and to live in accordance with the new American ways which these British descendants had developed in the new land.

Furthermore, we must remember that until the early 1800's the number of immigrants that had come to North America to live

was fairly small, at least in comparison with the 105,000,000 people in our country in 1920. The first census of the United States, in 1790, 170 years after the landing of the Pilgrims at Plymouth, showed that there were less than 4,000,000 inhabitants. After that time, however, the size of the population increased rapidly, especially because of the coming of a larger and larger number of immigrants. Note, for example, on the map of figure 224 that in the 100 years between 1820 and 1920 approximately 33,000,000 immigrants came to the United States from other parts of the world. Europeans began to emigrate to the United States in larger numbers in the second quarter of the nineteenth century. You will recall that at that time the Middle West was being settled rapidly, since there was much free land to be had for farming. Roads, railroads, and canals were being built, coal and iron were beginning to be mined, and factories were springing up. The United States was at that time becoming known to the poor and oppressed people of Europe as a land of golden opportunity.

Where did these millions of immigrants come from? The map of figure 224 reminds us that more than 95 per cent of them came from Europe or from Canada, which like the United States had been settled by Europeans. In 100 years only about 5 per cent of our population came from Asia and Central and South America. It is not too much to say, therefore, that the people of the United States are today descendants of Europeans. This fact is exceedingly important to remember in preparing for your study of life in Europe and other continents.

Figure 224 reminds us of another important fact; namely, that in the century from 1820 to 1920 the greater number of the people who emigrated from Europe came from either the British Isles, Germany, or Scandinavia. (Note the dotted area in figure 224.) There is no one name that completely includes all of these people. Sometimes they are referred to as *Nordics*. Some of them are spoken of as *Anglo-Saxons*; those who lived in Germany are called *Teutons*. Lacking an acceptable single name, therefore, we shall refer to these people as northwestern Europeans.

The next greater number of our immigrants came from eastern and southern Europe — Russia, Poland, Austria, Italy, etc. Most of these people were *Slavs*. Only a small per cent of all the immi-

grants to the United States for a century came from France, Spain, Portugal, the Netherlands, Switzerland, and Belgium. Indeed, we have received more immigrants from Canada than we have from the region of southwestern Europe (marked 2 on figure 224).

The principal peoples who settled the United States

Five chief groups have contributed people to our country:

1. The northwestern Europeans.
2. The Italians, from southern Europe.
3. The Slavs, of eastern Europe.
4. The Jews, who have come from many different European countries.
5. The Negroes, mainly from Africa.

We have already learned, in Chapter V, that the United States is peopled by immigrants of more than forty nationalities, and that the population is composed not only of many nationalities but also of many races. Nevertheless, the five groups mentioned above have sent by far the greatest number. One word of caution is necessary in thinking about them. As you will learn later more fully, the peoples of Europe are divided into more than a score of nationalities and races. In the countries of central and eastern Europe these people have intermingled so much that it is difficult to find words that will describe clearly their nationality or their race. People of several races live within one country. The people of certain races — for example, the Slavs and the Jews — have become scattered in many countries. We have selected the five terms used above, however, as the clearest and most convenient way of referring to the principal groups which emigrated to the United States.

The Northwestern European Immigration after 1790

We have already referred to the fact that before 1790 most of the emigration to North America was from England. After that time the three principal European groups to emigrate were the Irish, the Germans, and the Scandinavians. Next, therefore, we shall study briefly when and why these peoples came to the United States, where they settled, and how they became an important part of our people. First, the Irish.

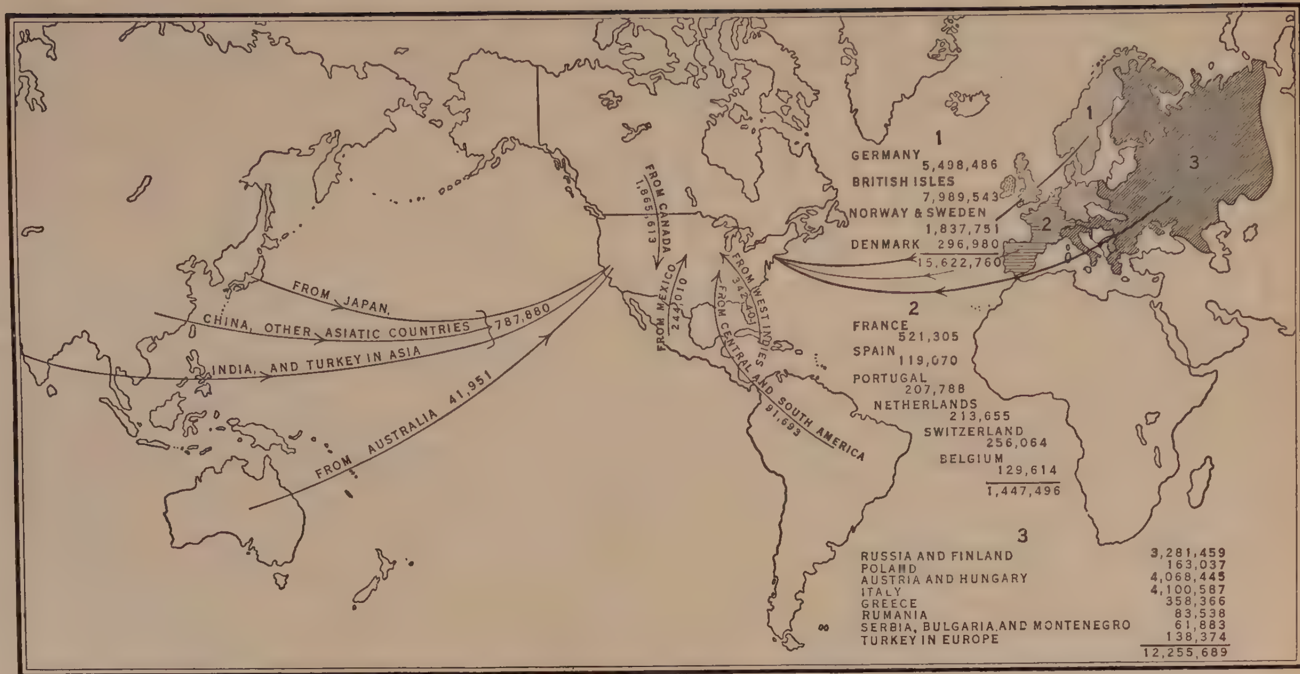

FIG. 224. Since 1820 approximately 33,000,000 immigrants have come to the United States. The map shows that most of them have come from three fairly distinct regions. Most of the immigrants from northern and western Europe came before 1890. Most of those from eastern and southern Europe came after 1900

1. The Irish came in large numbers after 1840

You have learned that after 1800, with the increased demand for laborers to build the roads, railroads, and canals and to work in our growing Eastern cities, many Irish people emigrated to the United States. The number was relatively small, however, until the 1840's. Then, as the graph of figure 222 shows, there was a great migration from Ireland. There were two reasons for this, famine and rebellion. A plant disease swept over Irish farms in 1846–1847. Potatoes and other vegetables, upon which people depended for their food, were ruined, and more than 200,000 people died. The people were even reduced to eating such things as the bark of trees and straw. So when Americans sent food in relief ships to be distributed to those near the port cities, many thousands of Irishmen came to the United States in the ships.

Figure 222 reminds us that there was another reason for this Irish emigration — rebellion in Ireland. For hundreds of years the Irish people had been oppressed by the English kings and Parliament, partly because many Irishmen were Catholic and many Englishmen were Protestant, and partly because of the growing Irish manufactures. The Irish people had learned to make useful things — woolen cloth, cotton goods, articles of glass and iron, etc. English manufacturers did not want their trade interfered with and persuaded the British government to forbid the Irish to manufacture or sell cloth and other goods. The Irish regarded this as a great injustice, and many of them, seeing little chance of improvement at home, emigrated to America, where they hoped to find life easier for them.

Most of them were poor. Because they had little money with which to travel or to buy farms, they settled near the ports through which they entered the United States (see figure 225). They laid the tracks of the new railroads around New York, Philadelphia, and Baltimore, and built the new macadam highways. They loaded the ships and cleaned the streets. They helped to dig the Erie Canal. They worked in the growing factories of New England. So it became the custom for most of the Irish to stay in the towns and cities of the East.

As the years went on, better opportunities opened up for them. They joined the police forces and the fire departments and found work in the skilled trades. They ran busses and drove the new horse-car lines in the cities. Soon, however, better positions were offered them, and their names began to appear more frequently as partners in large companies. Each decade saw them taking an increasingly responsible place in the government. Their children

FIG. 225. The dots show where the Irish, and American-born people of Irish parentage, were living in the United States in 1920. One dot represents 1000 people

received better and better education. Many descendants of these immigrants went to college — the boys entering various professions and the girls becoming teachers. Today many descendants of Irish immigrants are wealthy and influential.

As time passed and the children mingled with the descendants of other immigrants they married young people of other nationalities and had children in their turn; soon it became difficult to tell *their* descendants from the rest of our mixed population.

In this manner was one nationality added to our population and so mingled with it that today only a Mc' or an O' as the handle to a name, or perhaps a quick sense of humor, remains to distinguish a black-haired son of Ireland from a black-haired son of any other land.

2. About the same period (1845–1855) many Germans came to the United States, also

An Englishman who was traveling along the Rhine Valley in 1846 wrote: "Long files of carts meet you every mile, carrying the whole property of these poor wretches who are to cross the Atlantic." "These poor wretches" were Germans leaving their homes and making the long journey to the United States, which they also looked upon as "the land of opportunity."

They came because they could make a better living in America than in Germany. Most of them were peasants living in poor cottages and tilling their little farms with crude implements. They left these behind them and came to the New World, where they had heard that one could buy good land cheaply and make a better living. But there were others who came from Germany for a different reason — oppression by their rulers. In the 1840's many Germans were revolting against the government, trying to bring about one in which they could have a larger share. When the revolt failed, they had to escape quickly from the country, and naturally many of them found their way to the United States. Most of these revolutionists came from the cities. They were well educated and made fine citizens. These people, like the Irish and the English, came from an older country than ours — a country where art and science flourished. So you see they had much to give to their new land.

The Germans came in very large numbers even after the first migration of 1845–1855. All through the remaining decades of the 1800's they came by tens of thousands.

Where did the Germans go to live in their new country? The map of figure 226 shows that a few settled in the Eastern states. But most of them went west to Illinois, Wisconsin, and to the other fertile farming states of the northern part of the Middle West. As far west as Iowa, Nebraska, the Dakotas, and Minnesota, they staked out new farms. From these they produced and shipped out each year large amounts of wheat and corn and dairy products.

The map (figure 226) shows also that many of the Germans settled in the growing towns and cities. Note the black spots which show where tens of thousands of their descendants live in or near Milwaukee, St. Louis, Detroit, Cincinnati, Pittsburgh,

and Buffalo, in eastern Pennsylvania, and even along the Atlantic seaboard. In the cities many of them became successful business men. Many sent their children to college, from which they graduated to become lawyers, doctors, engineers, or ministers. Many went into teaching in our schools and colleges. Others became

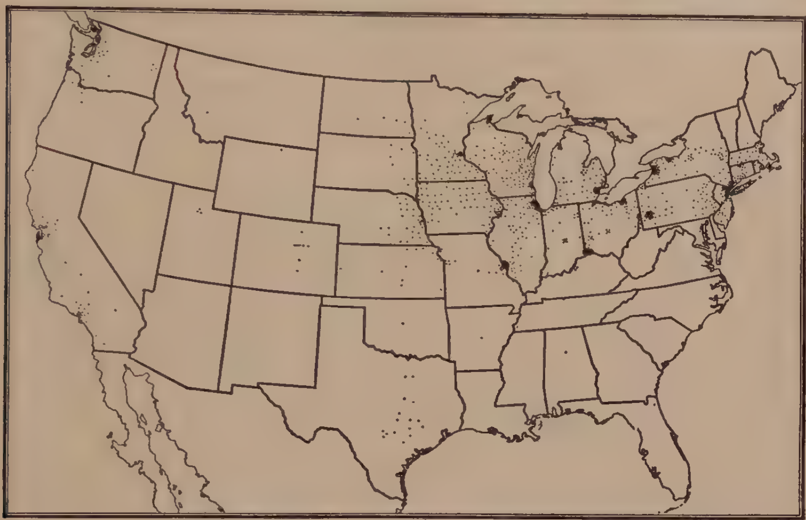

FIG. 226. The dots show where the Germans and American-born of German parentage lived in the United States in 1920. One dot represents 1000 people

musicians playing in our best orchestras. Today every profession contains many people of German blood. As the generations passed, the Germans too intermarried with other nationalities, and their children came to look very much like the children of people whose families had been here for 100 years or more. They also became "Americans." It has been estimated that one fourth of the American people now have German blood in their veins.

3. The Scandinavians came a little later (1870–1910)

Look again at the chart of figure 222. It shows that most of those who came to the United States from Scandinavia — that is, from Denmark, Norway, and Sweden — arrived after 1870. Although not nearly so many came from Scandinavia as from Germany and Great Britain, nevertheless nearly 2,000,000 came in the 40 years from 1870 to 1910.

These Danes, Norwegians, and Swedes formed an important immigrant group and contributed much to the United States. They, like the Germans, came here as children of the soil. The Dane, for example, had lived on his little farm of green fields and meadows. From his cows had come the milk which made butter and cheese for many European cities. The Swede too was probably a farmer on some fertile river valley of his homeland, or perhaps a woodsman cutting down the trees of great forests

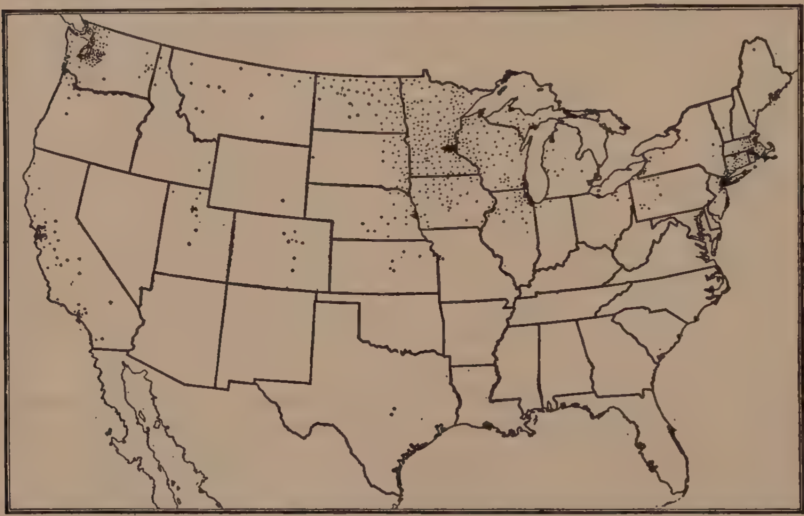

FIG. 227. The dots show where the Scandinavians and American-born of Scandinavian parentage lived in the United States in 1920. One dot represents 1000 people

and making logs into planks. The Norwegian had had a harder time at farming, for the farms in his country were small and rough and rocky. He, very likely, had been either a lumberman or a fisherman.

So it happened that many of the Scandinavians went to the north central states, where there was still plenty of farm land in the 1870's and 1880's. There they staked out homesteads and raised wheat and corn and other food products. Some of them became lumberjacks, some skilled mechanics. Note on figure 227 how they clustered together in Wisconsin, Minnesota, Iowa, and the Dakotas. Some of them went into cities as had the Germans, became skilled mechanics, or went into business and the

professions. Schools and colleges grew up in their part of the country, too, and their children went to them in increasing numbers. So it happened that Minneapolis and St. Paul and the smaller cities became largely Scandinavian in much the same way as Milwaukee and St. Louis had become largely German. But by far the greater number of these newcomers settled upon the land to earn their living as they had done in Denmark, Norway, and Sweden.

Like the Germans and the Irish before them, like all the nationalities which have contributed to our population, these Scandinavians soon mingled with people around them and helped to form the American nation. Their children often married children of other nationalities. They grew up without the peculiar speech accent of their elders, and today it is difficult to tell an American of Scandinavian parentage from one of British or German. The Scandinavians, like the other immigrants, were freedom-loving and industrious and had much to give to the developing nation. They too came here to stay permanently, and they have been proud to call themselves Americans.

The Eastern and Southern European Immigration after 1890

So from the countries of northwestern Europe came many millions of immigrants, and almost until the twentieth century these formed the bulk of the newcomers into the United States. Then came an important change: the number of British, German, and Scandinavian immigrants declined, while the number of Italians and the number of Slavs from Russia, Austria-Hungary, and other eastern European countries increased.

This is strikingly brought out by the graph of figure 222. Between 1899 and 1910 more than 8,500,000 people came from eastern Europe. More than half of these belonged to three of the five principal groups which we have named — Slavs, Italians, and Jews. They came through our Eastern immigration ports (New York, Boston, etc.) at the rate of more than 500,000 a year. Imagine such a flood of human beings coming to settle in a country in little more than a decade.

What were the Causes of this New Flood of Immigration from Southern and Eastern Europe?

One of the chief causes was that the United States had need of many laborers to do the increasing work of the industries that were developing from 1870–1910. It was during that period that factories, railroads, and coal mines developed most rapidly. The transcontinental railroads were being built. Cities grew astonishingly, demanding more houses, more timber, more coal, more railroads to transport people and supplies, and more and better highways. It was especially in the meat-packing, the iron, the steel, and the coal industries that more men with strong arms and backs were needed. Men must be found to dig the coal, to tend the blast furnaces, and to do the other heavy work of industries. In each generation it was the newcomers who did this work.

So it happened that the needs of American industries for more workers fitted into the desire of many of the peoples of southern and eastern Europe to find a new place to earn a living. They were the Italians, the Slavs, the Jews, and other eastern Europeans who were finding it hard to get a living in their own countries or were seeking relief from political or religious oppression. Their lands were poor, their countries were overcrowded, their farms were small, taxes and the costs of living were high. People were worn out with disease and hard times. They were oppressed by their governments and made to serve in armies whether they wished to or not. The United States seemed to them to provide an easier way to make a living. They felt they would be freer here and have a larger share in the government. Hard as the unskilled work may have seemed to them, it was welcomed by these new immigrants as a means of escape from worse conditions at home.

1. Millions of Italians emigrated to America after 1890

First we will make a brief reference to the Italians, who in large numbers after 1890 left their small sunlit fields and the narrow streets of their old towns and sailed away to the New World. In Italy most of them had lived on little farms crowded close together or in cities and towns. You can imagine how cramped

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FIG. 228. A group of Italian immigrants at Ellis Island during a Sunday-afternoon concert

their life of poverty was when you realize that in 1910 Italy numbered 36,000,000 people, — and it is a country no larger than the combined states of Iowa and Missouri! For hundreds of years their ancestors had struggled to earn a bare existence on their little farms by raising grapes and oranges on steep hills and mountain sides, by herding goats, and by tenderly caring for tiny garden plots. The story of the high wages to be had in American cities drew many of these people to the United States. They were living in poor one-room or two-room houses with almost no conveniences. They were hardly able to keep body and soul together.

FIG. 229. The dots show where the Italians and the American-born of Italian parentage lived in the United States in 1920. One dot represents 1000 people

So after 1890 they poured into our Eastern ports. By this time most of the free land of our Middle West was gone. They could not afford to purchase land and start new farms; so they took whatever work was at hand in the Eastern cities. The map of figure 229 shows where they settled. Notice the black spots which mark large numbers of Italians in and near Boston, Providence, New York, Baltimore, Pittsburgh, and the lake-port cities of the Middle West (for example, Cleveland). They became laborers on the docks and railroads, and in the shops and mills of the industrial zone. Some went into New England and worked as truck gardeners and farm laborers. Some became skilled mechanics. Many worked in restaurants, drove cabs, worked on construction gangs. Gradually they too have become more well-to-do. Steadily more and more of them have sent their children to school and to college. Already in our larger cities sons of Italian immigrants have become lawyers, doctors, dentists, teachers, and members of city, state, and national governments. They too are proving that they have something of importance to contribute to American civilization.

2. Millions of Slavs also came to the United States after 1890

In a previous section we reminded you that the word *Slav* is used to include most of the people who live in a great area of eastern Europe. The shaded area of the map of figure 230 shows what a large part of Europe the Slavs inhabit. Notice how many countries are included, some of them large countries: European Russia, Poland, Czechoslovakia, Yugoslavia, Bulgaria. This great territory, more than half the size of the United States, comprises several countries, but most of the people belong to the Slavic race. The diagram of figure 231 illustrates the many nationalities included within the Slavic race. It is these people, together with the Italians and the Jews, who have come to America in the largest numbers in the last few years.

The Slavs, therefore, much more than the British, the Germans, the Scandinavians, or the Italians, are a mixed people. In their veins flows the blood of many races and nationalities.

Their ancestors came from many different parts of the world and settled in eastern Europe.

For hundreds of years most of the Slavs have been farmers. In all that time their ways of farming have changed but little. Laboriously, barely keeping alive, they have cultivated the soil with primitive plows and other implements. Life in a Slavic village is not easy. Huts and houses are small, of few rooms,

FIG. 230. The shaded area shows where the Slavs live in Europe

built of mud or stone, wood or stucco. People cook, live, and sleep in the same room. Fathers, mothers, and even the older children all work in the fields. No one has an easy life, for it is only with much labor that the little farms yield enough to support a family. Life among the Slavs in Europe today is, indeed, much as it was the world over before the Industrial Revolution.

It is easy to understand, therefore, why several million Slavic immigrants have come to the United States since 1890. More than any other group, they took their places in the iron and steel mills, in the mines, and on the railroads. Wherever rough, heavy labor was to be done, these newcomers were to be found.

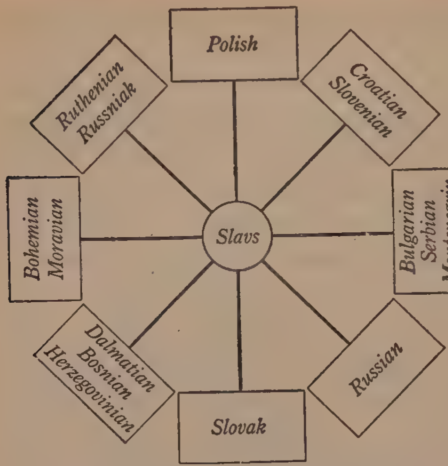

Fig. 231. This diagram names the eight chief groups of Slavic peoples. It shows us the many nationalities included within one race, representatives of which have come in such large numbers to live in the United States

For the most part the Slavs settled in or near the cities of our industrial zone—in Pittsburgh, Chicago, Detroit, New York, and Baltimore. Like the Italians and the Irish, most of the Slavs could not afford to buy land, and so they went to work in factories and in the iron, steel, and coal industries. At the time they began to come to this country the great steel corporations were still growing rapidly. The world was demanding more and more of our iron and steel. At the same time there was an increased demand for coal. Only people used to a life of toil could manage to live on the low wages paid for unskilled labor in these industries. The Slavs of eastern Europe were such people, and so they poured into the iron and steel industries by the thousands. Poles, Russians, Austrians, and Hungarians were all crowded together in our great industrial plants.

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Fig. 232. This is the first Russian family to reach New York after the World War

While they have not been in this country quite so long as the immigrants from the north of Europe, they are beginning to learn the English language and better

ways of living. They are beginning to find better jobs. Their higher wages enable them to dress better, eat better food, and live in better houses than they could have in Europe. Their working day in the United States is shorter than it was in their European communities. There is more time for leisure, and there is a little money left for simple recreations.

3. After 1890 millions of Jews also came to America

After 1890, with the rapid growth of American cities, opportunities to engage in trade greatly increased. The buying and selling of goods became more and more a special occupation, and the garment trades flourished, bringing a still greater demand for skilled laborers. Whereupon the Jews flocked to the United States in large numbers. The Jews, like the Slavs, came from many countries. They had no country of their own, as had the Italians, the English, the Germans, or the Swedes. For centuries they had been scattered in many countries over a large part of Europe. Hence we speak of Russian Jews, German Jews, English Jews, Austrian Jews, and others.

For many centuries also they had been city dwellers, either business men or workers in handicrafts and industries. Their staying in the cities and engaging in trade was often not entirely a matter of choice, for in many countries the laws did not permit them to own land. For example, in Russia, where about one third of the Jews resided, they were compelled to live within certain boundaries. They could not go elsewhere; they could not take up land or build their own farms, as our people have been free to do. Because they were compelled to settle in the cities, most of the Jews became workers in certain skilled trades, especially tailoring. They became business men and merchants, scholars, and professional men — but not farmers.

On coming to the United States — for them also "the land of opportunity" — it was natural that they should settle in the cities. Moreover, because most of our immigrants entered the United States through the port of New York, it was to be expected that a large proportion of them would settle there. Indeed, half of the Jews in the United States today live in New York City,

and within it there are great sections in which they comprise most of the population. They practically control the garment-making trades. Small stores and shops of every description are owned by Jews in almost every part of the city. To a smaller degree the same situation is true of Boston, Providence, Buffalo, Philadelphia, Chicago, Des Moines, and Los Angeles.

Our Dark-Skinned Citizens

Earlier in the chapter we said that the population of the United States was descended from five chief groups of immigrants. We have studied four of these, all of them from Europe — the northwest Europeans, the Italians, the Slavs, and the Jews. Each of these four groups, we have found, contributed many people to the population of the United States. Our list, however, included a fifth group, the Negroes, of whom there are today more than 10,000,000. As we learned in Chapter V, the Negroes make up more than nine tenths of all the people of dark-skinned races in the United States. If we include the other chief dark-skinned groups, our list will name Mexicans, about 500,000; American Indians, about 250,000; Chinese, about 60,000; and Japanese, about 110,000.

1. Our Negro population

For more than three hundred years there have been Negroes in America. During the first 250 years of this time they were slaves working for their masters in the cotton and tobacco fields of the South. The first shipload of Negro slaves was brought here from Africa in 1619. For 100 years the slave trade grew very slowly. People raised little cotton and needed few slaves. Each year, however, brought a few more to our shores, and in 1719 it was estimated that there were 59,000 in all the colonies.

In 1792, however, a northern school-teacher, Eli Whitney, invented the *cotton gin*, a machine that would clean cotton much more rapidly than it could be done by hand. The invention of this cleaning machine caused an increasing demand for slaves to pick cotton in the fields. No machine was invented for picking the cotton, and many more people were needed to do that in order to

keep the cleaning machines busy. The bar graph of figure 233 shows the results of such inventions. Between 1790 and 1850 the number of Negroes increased by almost 3,000,000. The English textile mills were demanding more and more cotton. Factories were growing also in our own New England. During this period the Southern states became known as the cotton belt and, with the increase in Negroes, as the "black belt." Even after Abraham Lincoln had signed the Emancipation Proclamation and declared the slaves free (1863) most of them still continued to live in the South. And how they multiplied in numbers — 6,500,000 in 1880; 9,000,000 in 1910; over 10,000,000 in 1920!

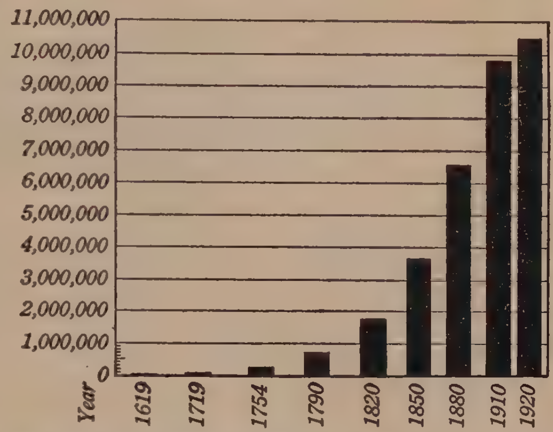

FIG. 233. This graph indicates the growth of the Negro population in the United States from 1619 to 1920

Until recently the Southeastern states were known as the black belt. This region is shown by the darker shading in the map of figure 234, on page 370.

Even after the Negroes were legally freed (1865), most of them did what they had always done — planted cotton and worked on farms. Some became farm laborers, some rented land, some bought little farms of their own; a few became laborers in the cities. After 1900, however, industrial opportunities in the North and the attractions of city life brought many Negroes to New York, Chicago, and other Northern cities. Figure 234, which shows where American Negroes were living in 1920, illustrates the movement to the Northern states. A similar map drawn in, say, 1890 would have shown the Northeastern and central states almost entirely lacking in Negro population. Even in our day, however, the few Southeastern states are still the "black belt." In the states of Mississippi and South Carolina

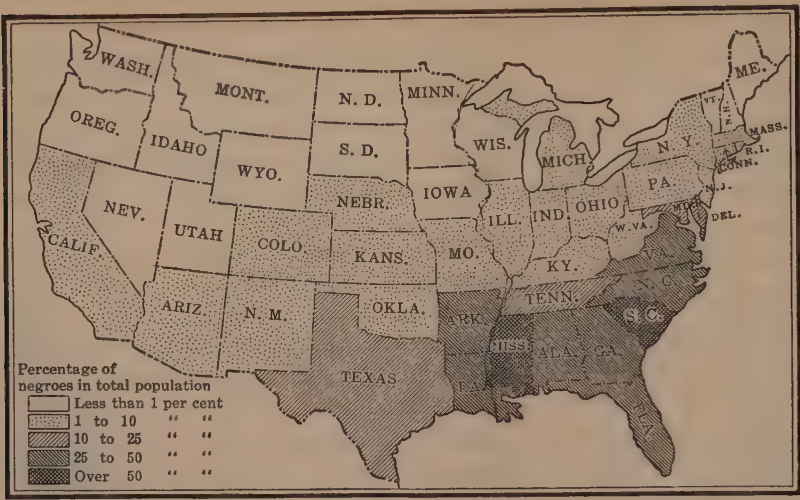

FIG. 234. Where the American Negroes were living in 1920

(see figure 234) more than half of the people are colored, and in Louisiana, Alabama, and Georgia nearly half are colored.

2. The other dark-skinned races in the United States

In addition to the Negroes there are about 1,000,000 other dark-skinned people in our country. These include Mexicans (about 500,000), American Indians (250,000), and Chinese and Japanese (about 170,000). In addition there are a few thousand each of other people who have come here from India, from the Philippines, from Hawaii, and from other scattered regions. Space is lacking to describe fully how these people happen to live in our country and what they do. A brief reference to them will not be out of place, however.

Consider the Mexicans first. They are descendants of the Indians who originally lived in Mexico and the Spaniards who settled there. Some Mexicans are more Spaniard than Indian. The poorer Mexicans are probably more Indian than Spaniard. It is the poorer people, the unskilled laborers, who come into our country seeking work. Living just across from the United States on the other side of the Rio Grande, they find it an easy matter to enter our country by crossing that shallow stream. They get

work in railroad gangs, in coal mines, in the oil fields, or on fruit ranches. Naturally, most of them have settled in the Southwestern states near the point where they have crossed the border. Of late a few have drifted North into the steel industries of our industrial region, and even into the agricultural regions of the Northwest.

What about the Chinese and Japanese? The first immigrants from China and Japan to enter the United States came in through Pacific ports shortly after the discovery of gold in California. With the opening of the gold fields (1849), Chinese laborers were much in demand around the mines. They washed and cooked while the white men did the more thrilling work of hunting gold. A few years later railroads were being built along the coast and eastward toward the Mississippi. Chinese, working at small wages, helped to construct these railroads. At that time the construction companies themselves brought in many Chinese laborers. The companies had discovered that the Chinese "coolies," as the unskilled laborers were called, had a lower standard of living and therefore would work for less money than would any other people.

The story of Japanese immigrants is similar to that of the Chinese. They also were brought to this country by American business men who were looking for cheap labor. But they are not important national groups today for two reasons: First, in most instances the Japanese and Chinese who came to this country were men. They did not settle or bring their families with them. The life in the United States was so different from the life in their homeland that many of them returned. Second, some years ago laws were passed by our Congress prohibiting further immigration of Japanese and Chinese. This has brought about a serious international problem, which we shall study later.

Summary: the American People, a Nation of Immigrants

In this brief review of the development of our people, one important point has been made — namely, that *we are a nation of immigrants*. From the first English colonists to the latest arrivals, the people who have settled the United States have been immigrants. In this chapter we have studied how they came from many countries and regions in one wave after another.

First there came a few early British colonists, who settled along the eastern coast, made the first thirteen states, and brought Negroes from Africa to do the work of the South.

Second, after the Revolutionary War, — and again after machines became more numerous, industries began to develop, and the land of the West was made available, — other Europeans emigrated to America, "the land of opportunity." They came from the country fields of Ireland to work for wages in our cities. They came from the farms and towns of Germany and Scandinavia to build the farms and towns of our central and Northwestern states. As time went on these earlier settlers became more and more prosperous. Gradually they either entered the highly skilled trades or went into business or the professions. Many of them became leaders in these fields.

Third, near the close of the nineteenth century, when our manufacturing industries had become great and there was a large demand for labor, people from the poorer regions of eastern and southern Europe came seeking a place to earn a better living. They came from the poor farms and crowded cities of Italy to work in our factories, on our railroads, or on our farms. The Slavs came from their poverty-stricken villages in eastern Europe. These people left their little farms, where work was hard and life was drab, and willingly undertook the hard jobs in the United States that others wanted to give up. Then it was, also, that the Jews came from cities all over Europe to the cities of the United States to do here much the same kinds of work they had done there. On our western and southern borders — the Pacific Coast and the Rio Grande — Chinese, Japanese, and Mexicans came, also, trying to establish themselves in a richer land and to earn a better living.

One fact about our people and their work is important: in every generation in American history it has been the newcomer, the recent immigrant, who has done the hard, disagreeable tasks. We shall study this problem more fully in the next chapter. But the United States has always stood to the immigrants as the land of promise. Although their lives here at first may have been hard and disagreeable, they were and are usually glad they came. There is always the hope that they, or at least their children, may become more well-to-do, as have the immigrants before them.

INTERESTING READINGS FROM WHICH YOU CAN GET ADDITIONAL INFORMATION

Books

ANTIN, MARY. The Promised Land. Houghton Mifflin Company, Boston, 1917.

*BEARD, ANNIE E. S. Our Foreign-Born Citizens. Thomas Y. Crowell Company, New York, 1922.

An excellent book, containing the life story of these immigrants who have become famous: Alexander Graham Bell, James Gordon Bennett, Edward Bok, Andrew Carnegie, George Washington Goethals, James Jerome Hill, Samuel Gompers, Charles Proteus Steinmetz, and others.

BOK, EDWARD. The Americanization of Edward Bok. Charles Scribner's Sons, New York, 1923.

*HILL, HOWARD C. Community Life and Civic Problems. Ginn and Company, Boston, 1922.

Chapter VI (Children of the Melting Pot) is a short account of the history of immigration and of some of the problems which these immigrants face in their new land.

HUSBAND, JOSEPH B. Americans by Adoption. The Atlantic Monthly Press, Boston, 1920.

ROBERTS, PETER. The New Immigration. The Macmillan Company, New York, 1912.

RUGG, HAROLD, and OTHERS. America and Her Immigrants. Stories of Immigration. Address: Harold Rugg, 425 West 123d Street, New York City.

STEINER, EDWARD A. From Alien to Citizen: the Story of My Life in America. Fleming H. Revell Company, New York, 1914.

Magazine Articles

*"Our Foreign-Born Citizens," *National Geographic Magazine*, February, 1917, pp. 95–130.

An excellent article, well illustrated, discussing the many immigrants arriving at America's door.

"The Immigration Stream Drying Up," *Literary Digest*, October 10, 1925, pp. 12–13.

CHAPTER XXI

GETTING THE NATION'S WORK DONE

It is 12.40 P.M. in the La Salle Street Station, Chicago, Illinois. The giant locomotive of the *Twentieth Century Limited* is ready to go. Fires are burning, steam pressure is up. Every bearing has been inspected and oiled. And yet this great locomotive is helpless, powerless to move an inch, without a man. Power there is in the great engine but it awaits command. A touch upon the throttle and this mass of steel becomes a tremendous force.

The engine was designed by man, and made by man. It must be controlled and operated by man. It is one of man's greatest aids, but it can never completely take his place. However cleverly machines are designed, however remarkable are the wonders they perform, they require the touch of human hands, the direction of human minds, to make them move and work. Even the "mechanical man" needs human guidance.

It takes men as well as machines to do the work of the United States

This is the Age of Giant Power and Giant Machines, but it is no less the Age of Men. It is true that every man, woman, and child in the United States today has many mechanical slaves working for him in the great power plants, locomotives, automobiles, and electrical machines. But these slaves *are* mechanical; they are brainless. They cannot think, they cannot plan, they cannot change their minds when it is necessary, because they have no minds to change.

Imagine the *Twentieth Century Limited* rushing up a track toward another train stalled on the same track. The engineer, seeing it, throws on the air brakes and the train stops in time to save 100 lives. Without him, the train would go on to destruction.

Suppose you want to send a telegram. You step to the tele-

phone and call Western Union. There is a delay of a few seconds and then a human voice, perhaps miles away, responds. As you give the words of your telegram, an experienced operator writes your message on a noiseless typewriter and repeats it to you. After a lapse of a few seconds the operator of another machine copies your message in telegraphic code. Before the last of it has been copied, the first of it is being received at the other end of the wire, hundreds of miles away, and copied at the same time on the familiar yellow blank by an automatic typewriter. Ten minutes after you have dictated your message the receiving operator at the far-distant station is calling your correspondent on the telephone and reading it to him. The machine a perfect instrument? Yes, but it is *only* an instrument. It is useless without the senses of human beings to guide it and control it.

FIG. 235. The man shown in the picture has only to move the lever which you see in his hand and the great crane like that shown in figure 239 moves in the direction and at the speed he wishes. But the crane cannot move without the intelligence of a man's brain and the guidance of his arm. (Courtesy of the General Electric Company)

Many other examples occur in all our larger industries. One such instance is modern farming, about which you will read in Chapter XXIII. The world is fed by machinery. Had mechanical reapers, binders, and threshers never been invented, farmers would still be grubbing laboriously at their few acres, aided only by hand tools, getting but a poor living by the most severe toil. But, again, these machines are only aids for men. They must be driven, oiled, repaired, and directed by human hands and minds. The world may be fed by machinery, but the machinery must have human guidance. We depend upon the farmer quite as much as we do upon his machines.

THERE IS AN AMAZING AMOUNT AND VARIETY OF WORK TO BE DONE IN A VAST COUNTRY LIKE THE UNITED STATES

In a recent year the Department of Commerce estimated that to feed the American people for the following year would require such great quantities of foodstuffs as the following: 600,000,000 bushels of wheat, 8,000,000,000 pounds of sugar, 14,000,000 pounds of salt, 1,000,000,000 pounds of coffee.

To heat their houses and to manufacture goods, Americans would have to dig out of the earth over 500,000,000 tons of coal.

To build railroad tracks, bridges, buildings, subways, and skyscrapers, the blast furnaces and rolling mills of the United States would have to produce 2,000,000 tons of steel.

To clothe our people would require 6,000,000 bales of cotton and 700,000,000 pounds of wool.

For the needs of manufacturing alone, 5,000,000 cords of pulp wood would have to be cut down.

So the figures run. The amounts are amazing indeed, always in six ciphers and often in nine. There are millions of jobs demanding millions of minds and hands.

Farmers	Bakers	Tailors	Architects
Lumbermen	Machinists	Stonecutters	Peddlers
Fishermen	Mechanics	Sailors	Teachers
Miners	Millers	Merchants	Stenographers
Carpenters	Paperhangers	Clerks	Electricians
Boiler-makers	Skilled workers in	Conductors	Milliners
Painters	many industries	Upholsterers	Cab-drivers
Dressmakers	Textiles	Doctors	Business managers
Jewelers	Shoes	Artists	Politicians
Masons	Steel	Musicians	Journalists
Engineers	Printers	Actors	Lawyers

FIG. 236. Some of the people engaged in a few of the 720 different occupations listed by the 1920 census

Not only is the work of the United States great in amount, but it is great in variety. In the reports of the Fourteenth census of the United States (1920), the work of our country is described in 720 different kinds of occupations. It is impossible for us to take the space to give all of them, but in figure 236 we have outlined the chief kinds. What a great variety! Jobs in producing food,

in making clothing, in building shelter; jobs in transporting people, raw materials, and manufactured goods; jobs in sending messages; jobs in buying and selling, and in banking; jobs in the professions of engineering, law, medicine, the ministry, dentistry, and scientific research.

All sorts and kinds of jobs for all sorts and kinds of people. Jobs for every interest; jobs for every ability. Head jobs and hand jobs, skilled jobs and unskilled jobs.

In 1920 the United States census reported that of our inhabitants there were about

41,600,000 persons working at gainful occupations — that is, those occupations which give them a return in money
21,600,000 children in school
41,800,000 persons not receiving a wage

The last group includes the mothers who take care of our homes, children too young to go to school, men and women who are not well enough to work, and a few hundred thousand idlers, who do not work.

In what kinds of jobs are most people engaged today? No doubt your reading of the previous chapters of this book would lead you to say, "In those which use machines." Your conclusion would be correct, as the bar graph of figure 237 shows. Of the 41,600,000 persons working for a wage, more than one fourth are engaged in the mechanical and manufacturing industries. Another fourth are engaged in agriculture and related occupations. Nearly one tenth are to be

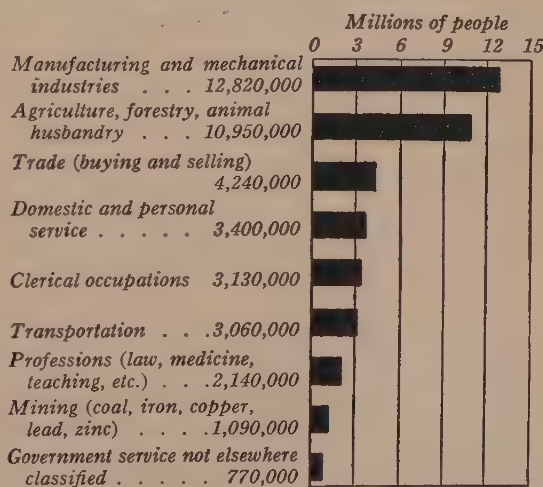

FIG. 237. Number of people engaged in each of the chief groups of occupations in the United States in 1920

found working in some job connected with transportation. That is, more than three fifths of all our workers are engaged in occupations which depend directly upon machines and mechanical power. Of the remaining workers, nearly half are engaged in buying and selling and in doing clerical work.

The nation's work demands both thinking and skill

There are many more kinds of work to do in this age of machines than there ever were before. Think back over the chapters that you have just read on manufacturing, transportation, and communication. Each new invention, each new machine, made more kinds of work. While the Industrial Revolution has wiped out some jobs, it has substituted others and added many new kinds of work. As you scan the list in figure 236 remember that almost any one of the occupations is divided into a dozen or more different kinds of work. There are, for example, several kinds of machinists, of printers, of textile workers, of miners, of painters, of dressmakers, of masons, and of stenographers. The shoemaking trade has been subdivided into scores of specialized jobs. So it is with engineering, transportation, and teaching.

To carry on these jobs of the nation demands thinking, skill, and in many cases muscular strength. Some jobs, like those in the professions of law, engineering, teaching, etc., demand more thinking than they do muscular strength. Other jobs, like those in the manufacturing trades, agriculture, forestry, etc., demand more skill than they do thinking. Nearly all jobs employ both to some extent.

The Nation's Work really depends upon a Few Important Thinking Jobs

Which is the more important, thinking or muscular strength and skill? It is difficult, if not impossible, to say. Both are important. The nation's work could not be done without both. One fact we have learned, however, from the preceding chapters of this book, and that is that the new civilization in which we are living today was made possible by the "thinking men." These men were the scientists and inventors, the men who dreamed of new ways of doing things. They were the men who put ideas to-

gether in new ways, and the men who organized and planned to apply these ideas to practical living. Such a man was James Watt, for example. He was a thinking man, and, making use of earlier inventors' ideas, he gave the world the steam engine and helped greatly to bring on the age of machine manufacture. Robert Fulton was another thinking man, and helped to give the world a new kind of water transportation. Thomas A. Edison is another thinking man. His electrical inventions have helped to bring about other changes in our way of living.

These are only three in a long list of thousands of thinking men who have given the people of the modern world a more comfortable standard of living. Since they made their first inventions, however, science has grown remarkably in extent. Its jobs, like those in the trades, have become specialized. Today there are many thousands of men employed by our larger manufacturing companies who spend nearly all their time in thinking jobs. These are the "research" men, and they are working all the time to improve ways of transporting things, of sending messages, and of producing goods, food, and machines.

But it is not only in industry that thinking jobs are important. In medicine, in dentistry, in the study of public health, in agriculture also, thinking men by studying our problems scientifically have played an equally revolutionary part. Such men have helped to prevent disease. As a result of their efforts people live longer today and with less illness than did those who lived in earlier centuries. When people are well their chances for happiness are greater. We receive great benefit from the men who do scientific work in medicine, in city-planning, in the study of water and food supplies, and in other similar fields.

Examples of our Many Skilled Jobs

Only a few of our people, however, are engaged in scientific research and in other professions. In 1920 this group comprised slightly more than 2,000,000 people, or about 5 per cent of our workers. In what industries were the others? They were engaged in either skilled or unskilled jobs in manufacturing industries, in agriculture, in clerical occupations, in mining, in transportation,

in stores, or in government work. In these occupations what kinds of work were they doing? Most of them were employed at jobs which, although they may require some amount of thinking, chiefly demand a certain type of muscular skill. They were running locomotives, driving taxicabs, building houses, running machines. Of course, each of these jobs requires some head work, some planning, and nearly all require habits of care and thoroughness. As compared with the "head jobs" of the professions, however, it would be fair to call the occupations in which most of the American people engage "hand jobs." Some of these are skilled, some are unskilled. Let us illustrate briefly each of these.

Consider the skilled occupations upon which the safe and prompt operation of our railroads depends.

A hundred miles ahead skilled workmen are getting ready for the coming of a train, such as the *Broadway Limited*. Whenever the swiftly rolling palace stops at a city, a crew of trained men is waiting to receive it. Almost before it comes to a stop they are at their posts, skilled inspectors, examining, testing, looking over every part. Quietly and quickly, but without haste, under it, over it, through it, they move, now climbing, now bending low. As you have stepped off the train for a walk along the platform you may have seen men in overalls gliding along each car, placing a bare hand on each bearing to test its temperature. But there were other workers, whom you may not have seen, inspecting lights, water supply, couplings, and many other things. Of course, there was the regular train crew, and there were the engineer and fireman, looking over every vital part of the giant locomotive.

Then the call of "All aboard!" and you step back into your car. It may be night, there may be snow or rain or zero weather outside, but you go comfortably to sleep. Far down the track at the next stopping point waits another crew to inspect the train with the same skillful care; and others again and again until the journey's end.[1]

The responsibility for the safety of the train is always the engineer's. He is responsible for the locomotive he drives, for the

[1] This story has been adapted from an advertisement of the Pennsylvania Railroad in the *Saturday Evening Post*, January, 1927.

lives of all the people in the cars, and for the goods he carries. His is the job of rushing them through the night over a black track at terrific speed, and of getting them to their destinations *on time.* He must use skill and brains to bring his train into the yard safely and promptly. To direct the great machines which run our world today men must not only understand all about their machines and be able to run them, but they must also be physically fit. They must have perfect control of their muscles. They must have clear heads and be able to think quickly. Steady nerves are needed not only to stand up against the noise and clatter and vibration and speed of machines but also to assume responsibility for many lives and to keep cool in danger.

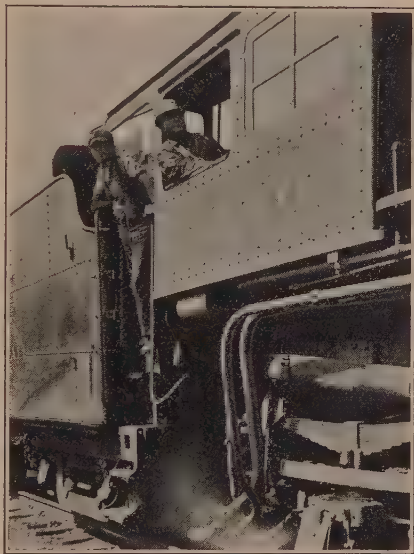

Fig. 238. The engineer takes the *Limited* through on time

The work of the railroad train crew illustrates only a few of many important skilled jobs in transportation. Trains, subways, street cars, elevated cars, motor busses, and river and lake steamboats must be moved promptly and safely. Figure 237 shows us that to do this today in the United States there are more than 3,000,000 workers. Practically every one of them is doing work that requires some thinking as well as skill.

So it is in the machine industries, in mining, and in the clerical occupations. Millions of workers are engaged primarily in skilled jobs. The work of the bookkeeper, the accountant, and the office clerk compels him to use mental skill that he has learned either in school or on the job. The weaver, the spinner, and the dyer in the textile industries are skilled operators of machines. The plumber, the machinist, the taxicab-driver, the boat pilot, and the coal miner must each have practiced his trade and developed skill.

Much of the Nation's Work, however, is done by Unskilled Labor

There are a great many jobs today which require little skill or thinking; for example, digging and lifting, collecting garbage, cleaning streets, picking up papers in the park, or cleaning houses. Men and women can work at these jobs without special schooling. They can learn them without any training as apprentices. Our railroads employ about 500,000 of them, while about 800,000 are to be found working in the mines of the United States. More than two million men who need neither skill nor training work on the farms of our country, and during the harvest season even this great number is greatly increased. In these unskilled jobs muscle is required more than brain. They usually mean hard and sometimes dangerous physical work. Nevertheless, they are so important that our new civilization could not go on without them. The manufacturing of steel, for example, absolutely depends at the present time upon large numbers of strong laborers. The following story illustrates how, in spite of our use of machines today, there is much laborious work in that industry that must be done by sweating men.

An example of hard unskilled labor in a steel mill

"We began at five-thirty — three of us Americans, one Italian boy, one Mexican, one Greek, and several Slavic and Russian fellows — the foreigners hardly able to say more than a very few English words, though all had been in this country a number of years. We shoveled or pitched broken bricks into big ladles, or boxes, in the 'underpit' beneath us at the back of the furnace. We piled the good ones. We took turns getting into the hot ruins. . . . We lifted and tossed and shoveled the bricks up to the platform for the others to carry and shovel. Occasionally we rested a few moments. At all times we sweated, especially when down in the ruins. Indeed, we had trouble to keep from fainting with the heat. After an hour or two the Greek grew so dizzy that he was let off from his turn of going down, which meant more frequent turns for the rest of us.

FIG. 239. Pouring molten metal in a steel mill. (Courtesy of the United States Steel Corporation)

"Always, bricks, bricks, and more bricks — hot, cold, and medium. After a day or two of bricks had passed, I asked somebody 'What time?' and was informed, 'Oh, about nine-t'irty.' I never was so surprised and disappointed. But I couldn't stop moving those bricks (I hate to think how I feel about bricks) until finally, at the end of what seemed a week, twelve o'clock came and we could eat our lunch out of our bags — a half-hour — and then start moving more bricks until six A.M."[1]

This hard work goes on constantly in the manufacturing of steel, of machines, in the mining of coal and iron, in most of the industries of our country. Our lives today also depend upon the men who are willing to do these laborious jobs.

A second example: harvest hands needed on the farm

Machines do a large part of our farm work, but there are periods of the year when much of it must be done by the muscles of men. Then it is that large numbers of farm workers are needed. At the harvest time on many farms, farmers send out calls for help. They say that if workers don't arrive to help them to gather the harvest their crops will be lost and city dwellers must starve. They offer good wages.

Then it is that the harvest "hobos" respond.

Tens of thousands of unskilled laborers — hobos, school boys, rovers, and other men out of work — pour into the great grain country of the Middle West every summer. They come on foot, on

[1] Whiting Williams, *What's on the Worker's Mind*, p. 14. Charles Scribner's Sons, New York, 1920.

passenger trains, on freight trains, by automobiles, by every kind of conveyance. On them the farmers depend to harvest the crops.

"There they come, Harry." "Yes, they're coming, all right. There must be 500 of them! Came in on the Rock Island and the Wichita Interurban and are hiking across to the Santa Fe. Must be headed for the Great Bend country." We were standing on the main street of Hutchinson, Kansas, — Harry Allen and I, — watching the harvest army as it passed through Hutchinson on its way westward. Under a cloudless sky the hot sunshine of the twenty-fourth of June was bringing millions of acres of Kansas wheat into swift ripeness, and the harvesters were pouring into southern Kansas by passenger trains, freights, and automobiles.

The spirit of the harvest was upon them. Each one knew that he was only one of 10,000 pouring into and out of the towns of Kansas, moving up through Texas, Wyoming, Arkansas, and Oklahoma, coming across the plains of Illinois, and drifting southwest from Omaha and Sioux City. Here and there knots of men were earnestly discussing where they would "hit for first." Others were making inquiries at depots and employment offices concerning crop conditions in different counties, or eagerly scouring the Federal harvest bulletins and local newspapers.[1]

We have space for only these two of the hundreds of kinds of unskilled jobs that must be filled to do the nation's work. Every manufacturing industry must have men who lift and carry and push and pull — helpers for the skilled mechanics. Transportation companies must have them; telegraph and telephone companies cannot carry on their work without them. Schools, churches, apartment and office buildings, all must have unskilled workers.

How the Life of the Worker was changed by the Industrial Revolution

1. From a farmer-craftsman into a factory operator of machines

You know from your earlier reading that before machines were invented work within the separate trades was not divided into many specialized jobs as it is today. The shoemaker made the whole shoe, the weaver did all the jobs of weaving cloth, and the

[1] Don D. Lescohier, "Hands and Tools of the Wheat Harvest," *The Survey*, July, 1923.

tailor made the entire suit. Even in 1800 most manufacturing was carried on in the homes by the farmers, their wives, their children, and servants, or by wandering mechanics. The following quotation from the diary of a nail-maker — Thomas B. Hazard, known as Nailer Tom — who lived in colonial times shows the variety of jobs that a colonial mechanic did in the course of a few months.

Made bridle bits, worked a garden, dug a woodchuck out of a hole, made stone wall for cousin, planted corn, cleaned cellar, made hoe handle of bass wood, sold a kettle, brought Sister Tanner's goods in a fish boat, made hay, went for coal, made nails at night, went huckleberrying, raked oats, plowed turnip lot, went to monthly meeting and carried Sister Tanner behind me, bought a goose, made a shingle-nail tool, helped George mend a spindle for the mill, went to harbor mouth a-gunning, hooped tubs, caught a weasel, made nails, made a weasel cage, opened the cow's hoof, split wood, made a shovel, made rudder iron, went an-eeling.[1]

Now the invention of engines and of machines puts an end to this variety of work. It took the farmer-craftsman out of his home and put him into a factory, where he tended machines. In the factory he did the same kind of work over and over. The worker became a starter and stopper of machines, going through the same kind of motions all day long. This was a great contrast to the varied work of earlier times. Although before the days of machines hours of work were long, the pioneer could change about from one job to another as Nailer Tom did. But with the coming of machines the worker was required to do the same thing day after day, year after year. So when machines were standardized and jobs were specialized, much of the work became monotonous.

2. From an independent farmer-craftsman to a dependent wage-earner

Before the Industrial Revolution most people in the United States worked for themselves. With the coming of machines, however, many went to work for other people for wages. We have already learned that in the early days of the Industrial Revolution

[1] Quoted from the *New England Magazine* (1890), by W. L. Chener, in *Industry and Human Welfare*, 1922, and reprinted by permission of The Macmillan Company, publishers.

machines were so expensive that only wealthy people could own them. Hence these people built factories and hired other people to work for them. The factories were located on rivers where there was water power, and towns and cities grew up around them. After machines were invented the worker could no longer live on his little farm miles away from town. Increasingly after 1825 people moved into cities, where they lived crowded together with other workers. As cities grew larger and larger land became more and more expensive, and the amount of land the worker could own or even rent for his home became smaller and smaller. The worker became still more dependent on his factory job, therefore, for his entire living. No longer could he raise his own food or make his own clothing. Most of these necessities he had to buy with the money which he earned in the factories.

Thus the coming of machines changed the life of the farmer-craftsman in a very important way: it made him a *wage-earner* and put him at the mercy of the factory-owner. The worker soon found that he must accept whatever wages his employer was willing to pay and work the number of hours that the employer demanded. Furthermore, if the employer chose to keep his factory dark and dirty, damp and unhealthful, the employee nevertheless had to work there. If he quit work because of his low wages or his long hours or the unhealthful conditions, he could move to another factory, but there the work was just as bad, and he had no other way to support himself.

This was a great change in the life of the worker. His father and grandfather had had farms with which they could provide at least the necessities of life by their own labor. They were relatively independent because they could produce their own food and clothing.

3. By combining in labor unions after 1800, workers secured shorter hours of work and increased wages

What would you do under such circumstances as we have described? Probably just what the workers of 1825 to 1850 did. If one worker alone was not strong enough to secure fair hours of work, demand reasonable wages, and healthful factory conditions, 100 or 1000 banded together might become strong enough to do so.

They saw that "in union there is strength," and so they formed *labor unions*. These have included a great many kinds of organizations, — societies, clubs, brotherhoods, — but they have all aimed at the same purpose, which has been to secure shorter hours of work, higher wages, and better surroundings.

So in the cities, almost as soon as there were factories, there were labor unions. Even before 1800 the shoemakers of Philadelphia had organized an association, and their experience led workers in other trades to follow their example. The first real trade union in the United States, however, was formed in 1827, more than a century ago, — the Mechanics Union of Associations of Philadelphia. This union was started by carpenters who had stopped work in a body and demanded a ten-hour working day. Their action in stopping work and refusing to return until certain requests were granted was called a strike. The men struck because of the long hours of work which were required of them — twelve to fifteen hours a day in summer and nine hours in winter. The rule was that they were to work from "sunup to sundown," but in the winter employers seldom hired men, because of the shortness of the days. Most of the building, therefore, was done in the summer when the days were very long. So the workers struck, declaring that "ten hours industriously employed" were sufficient for a day's labor. From that time to this there has been almost constant struggle between unions of workers and unions of employers over questions of wages, hours, and conditions of work.

In 100 years the working day of the skilled and semiskilled mechanics of the United States has been reduced from twelve or fourteen hours to eight or nine hours. This is partly due to the increased efficiency of machines, but mostly to the efforts of the labor unions. When the unions were first organized, a working day of twelve hours was common. The workers argued that the long hours of work were detrimental to health; that men could produce almost as much by working less time, because they would have more energy and could work faster; finally, that men could not become intelligent citizens without leisure time in which to "improve their minds."

The employers declared, on the other hand, that the reduction of the working day would open a "wide door for idleness and vice

and finally change the present condition of the mechanic classes, made happy and prosperous by frugal, orderly, ancient, and temperate habits, into a degraded state of discontent and insubordination." To such arguments the laborers replied with such other questions as: "Do you think a person is likely to have too much time for 'idleness and vice' if he works ten hours a day six days a week?"

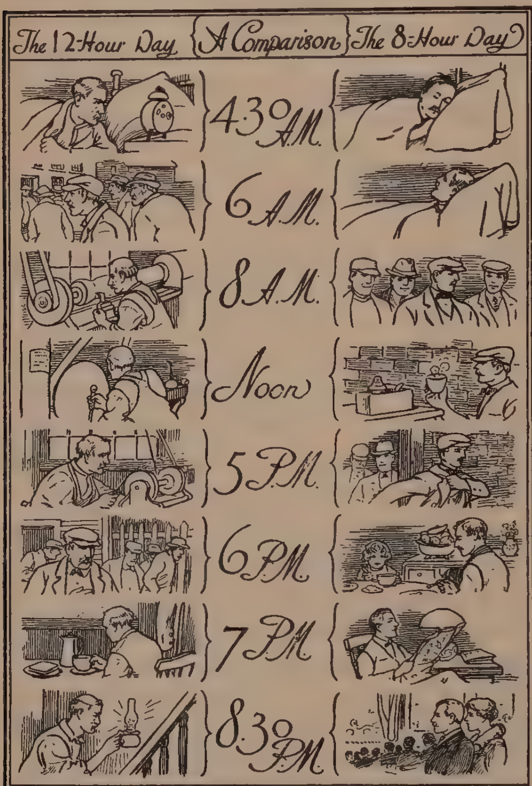

Fig. 240. These men may live in the same community. Which would be the better citizen? Which lives the more pleasant life? (Courtesy of the American Association for Labor Legislation, New York)

So until after 1860 the struggle went on for the ten-hour day. In some places it has persisted almost to the present time. In most of the larger cities of the country, however, the labor unions succeeded in securing the ten-hour day. No sooner had they won it than they tried to secure a further reduction in hours of labor. The national government also led in the movement to bring about the shorter day. In 1868 Congress gave employees on public works (roads, waterways, buildings, etc.) the eight-hour day. In the 1880's and 1890's the working day was reduced in some occupations to nine hours; in a few instances even to eight hours. Mechanics working for the government were also granted the eight-hour day. Gradually the workers in many trades and in many parts of the country secured shorter hours of work. In some cases strikes

were necessary. In others, employers saw that it was to their advantage as well as to that of the workers to have the eight-hour day. The struggle for the shorter working day also resulted in the passing of laws to protect women and children from excessive hours of labor. As early as 1867 several states declared that eight hours a day was long enough for women and children to work.

Although the goal of the eight-hour day has not yet been achieved by all workers, it is accepted as the length of the working day for most skilled mechanics. In our larger cities clerks in business offices are already working on a seven-and-a-half-hour day or eight-hour day.

Not only did the workers demand shorter working days; they insisted upon higher wages as well. Between 1833 and 1837 labor unions in the United States carried on 131 strikes for higher wages. Since that time nobody knows how many strikes have been held. Certainly thousands.

It is no wonder that at the beginning of the Industrial Revolution men struck for higher wages, since the amount of food, clothing, and comforts that people could buy with their low wages was pitifully small. In the early years of the Industrial Revolution, both in the United States and in Europe, the wages that the workers received would provide little more than a miserable home, insufficient food, and cheap clothing. By working from dawn until dark, they could earn barely money enough to allow them a decent place in which to live. Their homes were dark, rickety flats, lacking clean water, light, and air. After the rent had been paid for such a "home," barely enough money was left for food. To get clothing to wear or furnishings for the tenement required that part of the wages be saved, and there was little left to save.

The factory workers felt, therefore, that the invention of engines and machines had left them worse off than they had been on their meager farms or in their home handicrafts. They came to believe this even more firmly when only a few blocks away in their own community they saw people living in splendor and ease, surrounded by luxuries and displaying great wealth.

So the struggle of the labor organizations for a century was for higher wages as well as for shorter hours of work. Steadily, year

by year, their demands were granted. Wages increased as factories became larger, machines were improved, industries made more money, and more workers were needed. As the worker received larger wages, he was able to live more decently. Each increase in pay meant a lighter and cleaner tenement, better clothes and furniture, more education for the children. As the increase in wages enabled the worker to get a little more than the barest kind of living he looked about him at stores full of beautiful things and determined to have more of them for his family and himself. He saw colleges in which the children of the well-to-do were being educated. He saw fine carriages and, later, automobiles, which more and more people were driving. He saw better homes with gardens, which could be his, provided wages could be increased sufficiently to provide savings. So he joined hands with his fellow workers to demand a fair share of the income from the industry in which he worked.

Decade by decade mass production and standardized machinery made it possible to produce goods more cheaply. Decade by decade the workers joined together in each of the principal industries. The two factors — more efficient industry and labor organizations — raised the workers' standard of living. At the same time that hours of labor grew less, wages advanced. Although the cost of things increased also, there were more goods to be had. The homes of the workers grew somewhat better. People became much better dressed, and they had more food to eat. Little by little they saved money. Many owned small homes of their own. Their children stayed in school longer, more and more of them going through high school. There was often a little money left for the movies, the theater, a trip to the next city, or a boat ride on the river or the lake.

So it was that the conditions of most American workers improved. In a century hours of work decreased markedly and wages advanced. As a result of the machine production of things, practically all people are able at last to have not only the necessities of life but a few at least of the physical comforts and luxuries. The standard of living of the American people has improved decade by decade until today it is far superior, on the average, to that of any other nation in the world.

Summary

What, then, are the chief conclusions which we can draw from our brief study of getting the nation's work done?

First, we have learned that men as well as machines are required to do the work of the United States. Many men, indeed, are needed, for there is a vast amount of work to be done in our great country. Instead of taking away from men their means of earning a livelihood, the coming of machines has really increased the amount of work to be done.

Second, this work is of many kinds. There is work for men of different interests and abilities. The nation's work demands both thinking men and men of skill.

Third, we saw that the carrying on of the industries and professions of the United States depends, in the first place, upon important thinking jobs. In a large country like ours the mass production of goods, the prompt distribution of goods, and the efficient handling of trade, have been made possible only through the inventive genius of men of imagination.

Fourth, most of the nation's work, however, is done by skilled and unskilled workers. The carrying on of the work of the skilled workers demands some thinking but more physical skill, while that of the unskilled workers demands little thinking and skill but much muscular strength. Furthermore, machines are constantly being invented which will do more and more of the work of both our skilled and unskilled workers.

Fifth, we learned that the Industrial Revolution not only changed the production and distribution of goods but that it also changed in a most important way the life of the worker. In the first place, the farmer-craftsman stopped making things at home with simple tools and became a skilled operator of machines in factories. The farmer-craftsman changed from being a fairly independent worker to a dependent wager-earner. To protect himself against unduly long hours of work and low wages he joined hands with his fellow workers, and in 100 years, through the increased efficiency of industry itself, but mostly through the strength of his labor organizations, he secured shorter hours of work and higher wages.

Finally, we have learned that the Industrial Revolution did more than to increase the amount and variety of work to be done. Through engines and machines it increased the means by which it could be done. It also made it possible for all people to have more and better food and clothing, more healthful and comfortable homes, and some of the luxuries of life as well as the necessities. In short, the Industrial Revolution has improved generally the *physical* standard of living of people in industrial countries.

INTERESTING READINGS FROM WHICH YOU CAN GET ADDITIONAL INFORMATION

Books

*Bond, A. Russell. With the Men Who Do Things. Scientific American Publishing Company, New York, 1922.

An excellent first-hand description of work in building a skyscraper, in building bridges, in dynamite factories, and in dredging a river.

*Bragg, Sir William Henry. Creative Knowledge. Harper & Brothers, New York, 1927.

Chapter II (The Trade of the Smith), Chapter III (The Trade of the Weaver), and Chapter VI (The Trade of the Miner).

*Crump, Irving. The Boys' Book of Railroads. Dodd, Mead and Company, New York, 1921.

An excellent first-hand description of the work of the engineer, the train crew, the station agent, the man in the tower, the wrecking-train crew, etc.

Hill, Howard C. Community Life and Civic Problems. Ginn and Company, Boston, 1922.

Chapter XIII (Work and the Worker) discusses briefly the topics "Why People Work," "How Goods are Made," and "The Industrial Revolution."

Husband, Joseph B. A Year in a Coal-Mine. Houghton Mifflin Company, Boston, 1911.

Interesting and easy to read.

*Keir, Malcolm. The Epic of Industry (Volume V of The Pageant of America). Yale University Press, New Haven, 1926.

Chapter IX (Twin Giants), pp. 209–212, Chapter X (Logging and Lumbering), and Chapter XIV (Organized Labor in Industry).

*Lamprey, L. In the Days of the Guild. Frederick A. Stokes Company, New York, 1918.

A good description of the work of the craftsman.

Lamprey, L. Masters of the Guild. Frederick A. Stokes Company, New York, 1920.

Lyon, Leverett S. Making a Living. The Macmillan Company, New York, 1926.

Chapters IV, V, XII, XVI, XVIII, XX.

MARSHALL, LEON C. The Story of Human Progress. The Macmillan Company, New York, 1925.

Chapter XII (The Coöperation of Specialists).

*MOFFETT, CLEVELAND. Careers of Danger and Daring. The Century Co., New York, 1917.

Sections on the bridge-builder, the dynamite worker, and the locomotive engineer.

*WALKER, C. R. Steel: The Diary of a Furnace-Worker. Atlantic Monthly Press, Boston, 1922.

An excellent first-hand account.

*WILLIAMS, WHITING. What's on the Worker's Mind? Charles Scribner's Sons, New York, 1920.

The life of workers in coal and iron mines and in steel mills.

Magazine Articles

KELLOGG, PAUL U. "Henry Ford's Hired Men," *Survey Graphic*, February, 1928, pp. 549–593.

*KELLOGG, PAUL U. "When Mass Production Stalls," *Survey Graphic*, March, 1928, pp. 683–686.

"An Epic of Strife in the Forest Rangers' Life," *Literary Digest*, August 22, 1925, pp. 32–38.

"Forty Years a Daredevil." *Literary Digest*, May 30, 1925, pp. 38–45.

An excellent story of a building-trades worker — skyscrapers and bridges.

*"Machines Driving Men out of Work," *Literary Digest*, March 24, 1928, pp. 26–27.

CHAPTER XXII

THE RAPID GROWTH OF TOWNS AND CITIES IN THE UNITED STATES

THREE STORIES WHICH HELP TO EXPLAIN THE GROWTH OF THE CITY

1. A boy leaves the farm

"Mother, I tell you I've got to go to the city. I cannot stand this everlasting milk, milk, milk. Nothing to do but milk cows and plow and pitch hay and tend to the horses all day, year in and year out. I am sick of it. I want a change. Let me go to the city." And Ted Wilson threw himself on a chair, gloom written all over his face.

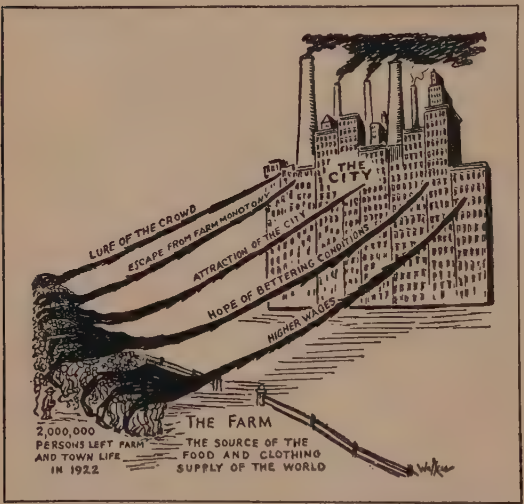

FIG. 241. The attraction of the city. (Courtesy of the *New Leader*)

"The city, Ted! That is all I have heard for a year. You really do not know the city or you would stay here on the farm with me. Why, you would hardly know your next-door neighbor if you went to live in a big city. Don't you remember what Uncle John said, that he lived in his apartment in Chicago a whole year and didn't know the people who lived in the same building? And the Emersons who lived in Philadelphia said the same thing. It was not until that awful accident to Mrs. Emerson that her neighbor across the hall even spoke to her."

"But, mother, think of the many things to do and the chances to find work. You know I don't want to stay and work on this farm. Think of the thousands of people to see! Fred Donnelly was telling me about State Street and the Loop in Chicago. Something going on all the time there, and here in this place I don't see a soul from one day to another. Then, too, you know I want to go to night school and learn to be an engineer, and I never will be able to out here."

"Yes, but you have no trade. You could not earn enough in the city to support even yourself, let alone me."

"Yes, but, mother, I am strong and I can get a job doing something and pretty soon I would get promoted and then I could send for you. We would not have to live in the city. We could get a little house outside in one of the suburbs. The electric service is fine and the steam trains, too. Why, you can go 30 miles out of the city as fast as you can go three here in the country with old Jerry."

"Yes, I know. Well, we'll see."

There are many farmers' sons like Ted Wilson, who leave their farms and go to work in cities.

2. A family moves to town

"There it is, mother," said Mr. Smith, holding out the paper to his wife.

FOR SALE

Farm, 200 acres, house, barn, all improvements. Five miles from city. Will sell very cheap. A. W. SMITH, R. F. D., No. 5.

"So it is," she answered.

She did not say any more. She felt too badly about leaving the farm, where she had lived ever since she had been married, 25 years before. Then there were all her friends and neighbors — she hated to go to the city and leave them.

"Cheer up, mother," her husband said. "We aren't dead yet, even if we can't make a living on the farm."

"That's right," she answered. "But getting a job may not be so easy in the city — not at your age."

"Never mind, I'll get one. There's nothing else to do. What we raise doesn't pay for itself on the farm these days. We'll be in good company, anyway. Two million people in this country left the farms last year. Just couldn't make them pay."

"A lot have gone from this neighborhood," his wife answered.

"Sure, there's Jones and Harrison, who left last year, and Thomas and Brown and Jenkins just left. Bad times for farmers."

"Well, I hope we won't starve in the city."

Mr. Smith was right. In a recent year 2,000,000 people *did* move from the farm to the cities.

3. An immigrant lands in New York

Ben Cavelli put on his good suit. He was going down to Battery Park to meet his friend Joe Antonelli, who would probably get in from Italy today.

It was a long wait, but Ben was patient.

Finally he heard the grinding of the ferry against the slip. And there among a group of Italians was Joe, looking somewhat scared.

The two old friends embraced each other.

"Come along with me," said Ben in Italian. "You will stay with me, and tomorrow I'll take you to the boss and get you a job."

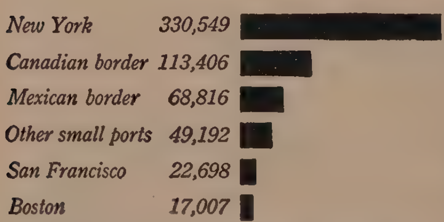

FIG. 242. This graph shows the number of immigrants who entered the United States in one year (1920) through the northern and southern borders and the various ports. Nearly all these immigrants settled in the cities through which they entered the country or in those cities nearest the border at which they entered. Does this fact help in any way to explain the growth of cities?

Another person had been added to the life of the great city; another worker for the factories.

Figure 242 shows one reason why cities grow rapidly. Joe Antonelli was but one of the thousands of immigrants who enter our country each year. Most of them settle in the cities.

Why do People move to Cities?

1. The chief reason: there is work to do in cities

The three stories that you have just read illustrate the first reason why people go to cities: people make their homes where they can earn a living. The city, with its factories, stores, transportation lines, and business offices, offers work to many people.

© Chicago Aërial Survey Company

Fig. 243. In a city like Chicago, where much manufacturing is done, there is work for millions of people

The man, for example, who was not able to make his farm pay, moved to the city, where he hoped to find work. The boy who wanted opportunity for work expected to find it in the city. The immigrant, the newcomer to the United States, looked for work in the city that received him. First and foremost, therefore, cities have grown because opportunities for work have increased.

If there were space we could illustrate this fact by showing the increase in many kinds of city jobs — for example, in transportation, in government and business offices, in stores, in education, and

in manufacturing. We have space for only one illustration, which shows the rapidity with which Chicago grew in population and in manufactured products in 60 years. In 1860 Chicago had less than 100,000 people. In 1920 it had more than 2,500,000 people. The following figures show how the value of manufactured goods in Chicago increased in the same years. In 1860 less than $100,000,000 worth of goods were manufactured in Chicago. In 1910 almost $1,500,000,000 worth were manufactured. Then, from 1914 to 1918, the World War, as you will learn later, caused an unusually large increase in manufacturing in American cities. In the year 1919, more than $3,500,000,000 worth of goods were manufactured in Chicago alone. The United States has scores of other cities in which manufacturing is going on. Most of them are not nearly so large as Chicago, but a vast amount of manufacturing goes on in them. Manufacturing, of course, demands workers; so people are moving in increasing numbers into the cities. The city, like a great magnet, draws workers to itself.

2. A second reason: there are many organized activities and amusements in cities which provide entertainment and employment

There is a second important reason why people go to live in cities. They not only hope to find opportunities for work, but they want other things too. They want amusement, they want to meet people who are interested in the same things in which they are interested. People like doing things in groups with other people. In cities they can live a very sociable life. In cities the standard of living for most people is higher than in villages and rural districts.

Consider the kinds of organizations that have their headquarters in cities. There are many labor organizations. Each of the important professions has one or more organizations. Each of the fine arts is represented in organizations. Each of the chief nationalities has an organization and maintains offices in the cities. There are many patriotic societies. There are scores of fraternal organizations. Then there are organizations whose members work for cleanliness in movies, books, food, etc., or for beauty of buildings, parks, gardens, etc. There are associations which pro-

vide help for the sick and poor. In the cities, also, many kinds of amusement are found, some of them free. In one of our largest cities there are more than 1500 different associations.

In the same city in a recent year there were more than 400 theaters, 300 movie houses, 700 public dance halls, 1600 churches, 40 hospitals, 80 asylums and homes, 20 museums, and 80 public libraries.

These organizations and institutions must have workers to direct them and to carry on their work, just as the manufacturing trades, stores, and business offices need workers. Tens of thousands of persons are employed in such organizations in a single city alone. They must be housed, fed, and transported over the city. They must have doctors and lawyers and ministers. Their coming to the city to live makes it necessary for still more workers to come.

3. Opportunities for education attract many people to cities

There are more than 800 colleges in the United States. Almost every one is in a city and helps to draw many people to live there. In addition, there are thousands of excellent high schools in our cities. These attract people from villages and small towns who desire a good education for their children.

In the past few years normal schools, colleges, and state universities have grown at unexpected rates. Practically every state now has a large enrollment in its state university. In a recent year the University of Illinois contributed to the population of the cities of Champaign and Urbana more than 13,000; the University of Wisconsin contributes more than 8000 to the population of the city of Madison; the University of Iowa adds more than 8000 to Iowa City. Cornell University at Ithaca, New York; Harvard in Cambridge, Massachusetts; Yale at New Haven, Connecticut; Dartmouth at Hanover, New Hampshire — all these universities have helped to build up the communities near them.

We need not name more instances. There are hundreds of communities, small and large, which have been built up in part by the presence of colleges, normal schools, engineering schools, musical institutes, training schools for nurses, teachers' colleges,

and many other institutions. Each of these institutions brings to the city many human beings, who have to find a place to live, who have to be fed, clothed, conveyed, and amused. In education,

© Keystone View Co.

FIG. 244. These two pictures illustrate the rapidity with which American cities are growing. The upper one shows a street in New York in 1900. The lower shows the same site in 1924

therefore, we find another reason for the growth of the city, with its stores and its clerks, its street-car conductors and its motormen; with its shopkeepers, traffic officers, firemen, health officers, and municipal officials.

The pictures of figure 244 show that where about twenty people lived in 1900, hundreds are living today. Five-story apartment houses set close together have replaced low wooden buildings.

City Populations have grown even more rapidly than Total Population

Figure 245 shows that our population has grown very rapidly. There were approximately 4,000,000 people in the United States in 1790; there were more than 105,000,000 people in 1920. Our population increased so rapidly that at the end of 130 years it had grown more than 26 times as great. It is important to remember this, for we shall find that all manufacturing countries have

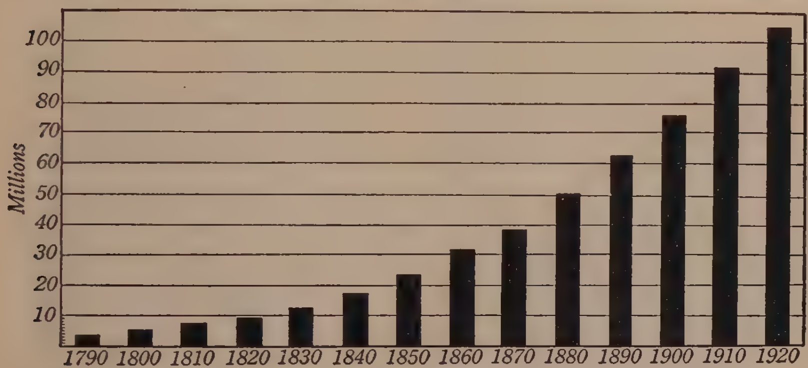

Fig. 245. The number of people in the United States, 1790–1920

grown rapidly during the same time. But city population and total population have not grown at the same rate. The following table is a striking reminder of the fact that our city populations have grown much more rapidly than our population as a whole:

Number of wage-earners grew twice as fast as population
Number of miners grew three times as fast as population
Number of city dwellers grew three and a half times as fast as population
Number of clerks, salesmen, and typists grew six and a half times as fast as population
Number of transport workers grew twenty times as fast as population

Why do Cities and Towns grow up at Particular Places?

Have you ever wondered why your town grew up just *where* it did? Was it a matter of chance? Could it have been located just as well some miles away? Was there something peculiar about the spot? Have the location of your community in mind as you

read of the reasons why three typical cities, Providence (Rhode Island), Pittsburgh (Pennsylvania), and Schenectady (New York) were first settled and why they grew to be important cities.

The first example: Providence, Rhode Island

About 300 years ago a little band of colonists left the new settlements in eastern Massachusetts and pushed southwest through the wilderness, hunting a place to start a new community. Little of the land was already settled. They might have stopped anywhere and made their homes, but they needed a location where they could earn a livelihood and where they could be comfortably fed and sheltered. They came finally to a great bay, into which two small swift rivers flowed. The coast was thickly lined with forests, which would supply timber for their houses, game for food, and furs for clothing. The rivers offered easy means of transportation to the inland country. The bay provided fish and a connection with the other towns on the coast. So the colonists chose that site on Narragansett Bay and named their new settlement Providence.

They cleared small patches of ground and raised grain. Some of them sailed their fishing boats through Narragansett Bay and down along the coast as far as Long Island Sound. As time went on and more people settled in Providence, industry grew. People built larger ships for fishing. More people went into lumbering and shipbuilding. At first the lumber for the ships was cut and planed by hand with simple tools; but gradually sawmills were built along the banks of the rivers, and planks were cut from the logs by machines run by water power. This meant that more ships could be built, because lumber was more quickly prepared for use in shipbuilding. As larger ships were built they were used not only for fishing but for trade.

Gradually ocean commerce grew. Soon Providence people were engaged in a world-wide trade. They bought sugar and molasses from the West Indies, brought it to Rhode Island, and made much of it into rum. They shipped the rum to the coast of Africa and exchanged it for negro slaves, whom they brought back and traded for molasses and sugar again in the West Indies and

for cotton and tobacco in the Southern colonies. Trade was also carried on with Europe and even occasionally with Asia.

In the meantime Providence people needed manufactured goods, which at first they bought from Europe. They gave in exchange tobacco and rice, flour, salted fish, furs, and timber. After 1800, as spinning and weaving machines were improved, cotton-manufacturing mills were built along streams near Providence. As the shipowners of the city brought larger quantities of

Fig. 246. A photograph of textile mills built on one of New England's rivers many years ago

cotton from the Southern states the spinning of yarn and the weaving of cloth grew into an ever increasing industry. More people — newly landed immigrants and people from the farming districts which had grown up close by — came to Providence to work. Steadily the city grew.

Later steam power slowly took the place of water power. The Providence business men brought coal from the Appalachian region to run their mills and factories. Other manufacturing industries grew. Foundries and machine shops, jewelry and dyeing establishments, were set up. Since all these industries required both skilled and unskilled laborers, the population increased. More houses were built, more stores were needed. Public and private buildings became more substantial, schools and churches

sprang up. Every addition to the work of the city increased somewhat the need for still more people.

Today Providence is a great manufacturing and trading city with a population of 286,000. Its growth illustrates the importance of a favorable location.

The second example: Pittsburgh, Pennsylvania

In the previous chapters we have referred several times to the settlement which grew at the point where the Monongahela and

FIG. 247. One of the largest steel mills in the busy manufacturing city of Pittsburgh. This city grew from a settlement located at the point where the Allegheny and Monongahela rivers joined to form the Ohio

Allegheny rivers join to form the Ohio. (See the relief map of figure 179, Chapter XVI, and figure 247.) As early as 1754, French traders had established a fort and trading post at this point. Standing as it did at the head of the Ohio River, it was a natural gateway through which Westward-moving colonists must pass. In 1759 British troops, aided by the colonists, captured the French fort and renamed it Fort Pitt after William Pitt, who was at that time the prime minister of England. In the following year, as the Westward movement of settlers increased, a town grew up around Fort Pitt. By 1800 the thriving community of Pittsburgh con-

tained several hundred houses. As you have learned, it was the head of navigation on the Ohio, and after 1811 a growing steamboat business brought more people to live there. Stores grew in number; machine shops and other factories were built along the rivers, making use of the water power. When railroads finally joined the Ohio valley with the Eastern cities, Pittsburgh became an important terminal and junction point. Railroad shops and offices were established there, bringing more workers. The location of the city on important east-and-west railroad lines also stimulated trade and brought new industries. During the early 1800's rich deposits of coal had been discovered in Pennsylvania and West Virginia, within a comparatively short distance of Pittsburgh. So, because of its favorable location for transportation and because of its nearness to coal mines and to other cities in the industrial region, many business men chose Pittsburgh as the site of their manufacturing establishments.

Largest of all the industries that settled in Pittsburgh was the steel industry, of which you read in Chapter XI and in Chapter XVI. After 1870 the iron from Minnesota mines was brought by Great Lakes steamers and railroads to Pittsburgh in the heart of the coal district. As the years went on, Pittsburgh took its place as the center of the great iron and steel industry. Today one sixth of all the iron and steel tonnage in the world is produced in Allegheny County, where Pittsburgh is located, and more than 1,000,000 people live there.

The third example: Schenectady, New York

In colonial days one of the principal means of livelihood for the settlers who lived in the Mohawk valley in central New York was trading with the Indians. Much of this trading was done up and down the Mohawk River, which lies in a broad valley. This river flows southeast into the Hudson, and just before it pours itself into that river there is a very long, shallow stretch with rapids and waterfalls. These acted as a barrier around which the traders and Indians were forced to carry their canoes and goods. This was called a "portage" or "carry." The Indian name for this word was *Schonowe*, meaning "gateway."

In 1662 a Dutch trader brought a band of settlers from the place where Albany now stands, across the 16-mile waste land to the falls in the river. There they stopped and built their settlement. They knew that everyone coming up and down the river would be obliged to pass their community and that, therefore, it would be a good place for trade. History proved that they were right. Hunters came there to exchange the skins of animals for guns, ammunition, and food. Traders came there to buy the skins. Gradually the settlement grew as more and more people came up the river. Some stopped and decided to settle there and "Schonowe" became the thriving town of *Schenectady*. For many years it was a frontier town and was always in danger of raids by hostile Indians. More than once it was attacked. Many of the English and Dutch townsmen were killed. But it was such a good trading place that in spite of the danger people persisted in going there to live. After a while manufacturing started because the falls provided excellent water power. Stores were opened to provide necessities for the workers in the factories; the settlement became a town. In 1825 the Erie Canal was completed. Schenectady was situated along its course, and as travel and freight traffic grew Schenectady, like the other cities of the Mohawk valley, profited by it.

After 1830 the first railroads were built up the Hudson and through the level Mohawk valley. One of the very first of these joined Albany and Schenectady. When the railroads of that region were joined in the New York Central system, Schenectady became an important railroad town.

As steam power began to replace water power in the factories of the United States, Schenectady too began to use this kind of mechanical power. By means of the new railroads coal could now be brought easily from the mines of Pennsylvania. This enabled more and more businesses to locate there, and the city grew rapidly in size. Today it numbers about 93,000 people. Of these about 20,000 are employed by one manufacturing company alone.

The history of these three cities is like that of many cities. It shows that the chief things which determine a city's location and growth are access to trade and industry

1. What makes a Good Trading Point?

a. Good transportation

The three cities which you have studied all grew up on rivers, at locations favorable for transportation. Easy transportation is responsible for the growth of every large city and most small ones. Look at figure 252. Of the 21 cities shown on that map most of

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Fig. 248. A picture of some of the docks on the Hudson River side of New York City

them are situated close to rivers or other bodies of water. Furthermore, most of the largest cities are either ocean or lake ports.

Consider what an advantage a good harbor on the seacoast is to a community. Trade! Boston, New York, Philadelphia, Baltimore, New Orleans, and San Francisco all grew up primarily because of good harbors.

In settling a new region men often sail along the coast until they find bays and inlets which are protected from winds and stormy seas. A well-sheltered harbor was the chief reason why the English Puritans built a village at the site of Boston when they came to America in 1630. As ships grew larger and Boston's trade

became more important the harbor was improved. But the fact that Boston was settled where there was a good harbor is one of the chief reasons why a great world city grew there.

Thus, because cities depend on trade, good harbors explain why our port cities grew. Safe harbors are the chief reason why Long Island, Manhattan Island, and the Jersey shore opposite it were settled so early by the Dutch. These good harbors largely explain why the cities of New York, Brooklyn, and Hoboken and others along the New York Bay, grew there. In the harbor of New York the anchorage space is today larger than that of any other port in the entire world. The channel is over forty feet deep, and even at low tide ocean vessels can enter.

New York Harbor has another advantage over others. It is not only unusually deep but at this point the tide rises and falls only about five feet. This makes it much easier for ships to ride at anchor.

In the port there are more than 700 docks at which vessels can load and unload cargo, and there is room for many more should they be needed. In fact, if one followed the shore line along the harbor, he would find it to be more than 770 miles long! Is it any wonder that cities have grown up alongside it? New York's Harbor now has more merchandise passing through it than any other port in the world. In a recent year more than 20,500,000 tons of merchandise either entered or left it. In the same year all the ports of Europe combined handled only a little more than 28,000,000 tons.

San Francisco became a well-populated community largely because of the wonderful harbor which lies behind the Golden Gate, the well-protected San Francisco Bay. New Orleans became an important city not only because it was located on a good port but also because it lies close to the mouth of the Mississippi River. Baltimore and Philadelphia too were settled near points where rivers flowed into the ocean.

Many more illustrations could be given of the advantage to a city of good water transportation, but there is not space for them here. Location on railroad and highway systems provides similar advantages. Compare the map facing page 48, which shows the location of our larger cities, with the map of the principal railroad systems (figure 166, Chapter XV) and the map of the principal

highways (figure 153, Chapter XIV). Note that most of our larger cities are in the eastern half of the country. Correspondingly, most of the railroads and the largest number of improved roads are there. We must not forget, indeed, that many towns were located along the route of the new railways almost at the moment these were being built. Sometimes they grew from the railroad camps which housed the workers. We frequently hear the railroad builders of the United States referred to as "empire builders." This means that when railroads are laid down, population will follow. By building a means of easy and rapid transportation the "empire builders" made it possible for people to live on the prairies, or even in the mountains, where, without transportation, it would have been almost impossible.

b. Nearness to markets

No matter how excellent are the harbors and the means of transportation in a given location, a city will not grow unless there are other favorable conditions. The chief of these is nearness to markets — to other places where people are living who will buy or sell goods. Remember that nearly half the people of the United States live in the industrial zone. Remember also that 90 per cent of our largest cities are in that region. In the industrial zone there are millions of people who need many kinds of goods. It is in this section of the country, therefore, that the largest amount of trading goes on. Expressing it differently, we can say that in this section are the great markets of the country.

Chicago is a good example of a trading center which has grown up because it is centrally located and is close to vast supplies of all kinds of products which are needed by millions of our people. As shown on the map of figure 249, it is located at the southern point of Lake Michigan, in the industrial zone. Chicago is rapidly becoming the greatest central market of the nation. Its wholesale businesses buy food, raw materials, and manufactured goods from all over the country and sell and distribute them to almost every section of it. Refer to the map of railroads, of highways, and of waterways in the United States. Note how these lines of transportation go out in all directions from the hub at Chicago.

This same reason — nearness to markets — accounts to a great extent for the growth of our largest Eastern port cities, — Boston, New York, Philadelphia, and Baltimore. It accounts also for that of New Orleans on the Gulf of Mexico and of San Francisco and Seattle on the western coast. The Eastern port cities sell largely to the people of European countries. The Western port cities sell

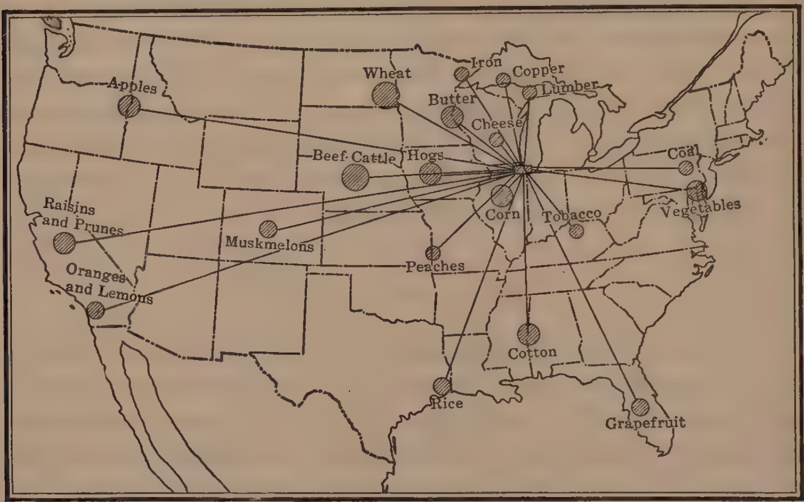

Fig. 249. This map illustrates the fact that Chicago is a great central market for the trade of the nation. It draws food, raw materials, and manufactured goods from all over the country

to people of the Far East. The Eastern cities are located on the most important trade routes of the world. These trade routes connect the Eastern ports of the United States, first, with the cities of northwestern Europe, and, second, with the cities of southern United States and of Central America and South America. Note in figure 250 the heavy band of trade that joins New York, Philadelphia, Baltimore, and Boston with the port cities of the British Isles, France, Germany, and other European countries. More goods and more people are carried on this ocean lane of trade than on any other in the world. Every year thousands of ships sail from the great Atlantic ports of the United States. These ships carry to the ports of Europe millions of tons of wheat, iron and steel, oil, and manufactured goods. They return to the United States with their cargoes of European goods.

Boston, New York, Philadelphia, and Baltimore are located almost exactly opposite the important European ports. Los Angeles, San Francisco, Portland (Oregon), and Seattle have, in a smaller way, developed into large cities because of their trade with the cities of the Orient and of the Hawaiian and Philippine Islands. Furthermore, since the opening of the Panama Canal,

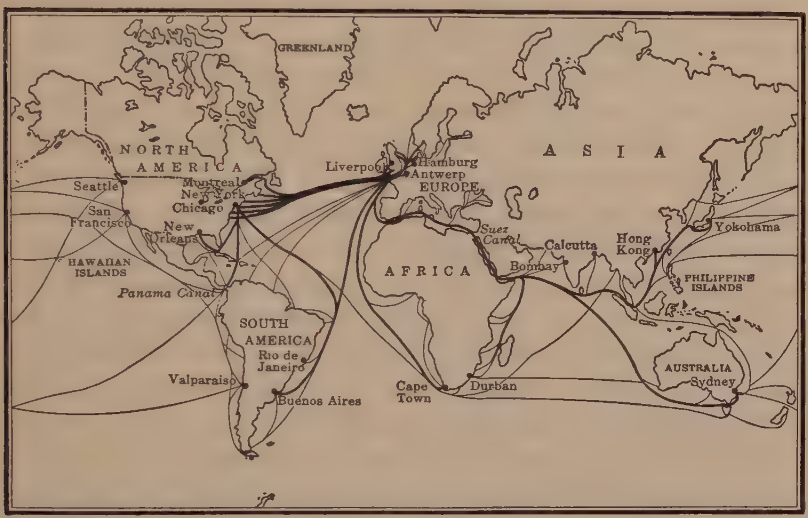

FIG. 250. This is the trade map of the world. The width of the black bands shows approximately the amount of freight carried between the principal ports. It will help to explain why the port cities of the United States became so large

the port cities of our western coast are joined more closely to those of our eastern and southern coasts. Finally, note the band of trade between New Orleans and the ports of Central America and South America.

c. A rich "hinterland," or producing region

Hundreds of towns have grown up in the United States, however, for reasons other than good transportation or nearness to markets. Perhaps your town is one of these. Perhaps it is not on a river, nor on one of the Great Lakes, nor on the coast; perhaps it is not near great markets. Perhaps it is just like many other towns — lying in the midst of rich farms. Many communities in our country grew to considerable size primarily because the

farmers of that region needed a central community through which to buy goods and to sell their products. At the last national census there were approximately 12,000,000 farmers in the United States. These farmers must buy supplies which they cannot raise themselves — groceries, tools, implements, and clothing. So in the midst of farms villages always spring up. A general store is usually found, a grain elevator is sometimes built, and possibly a flour mill. Eventually a bank is opened. A lumber yard is started to handle the lumber that is needed for the houses of the town. More workers come, and the community grows. For handling hardware and farm implements more stores are necessary, and clerks to run them. Farmers buy automobiles; so filling stations and garages are needed to furnish gasoline and to keep the automobiles in repair. More clerks are needed as well as mechanics. As the community grows, schools and teachers are required for the children.

We call the region which supplies a town or a city with trade in food, raw materials, or other goods the *hinterland*. The region may consist of any kind of land — land containing coal or iron mines, forests, garden vegetables, fruits, cattle, or wheat, or all of them.

The growth of many of our larger cities has been due to the fact that they have had an important hinterland. Chicago, for example, is located in the chief industrial section, near the coal mines of Illinois and Indiana, and has excellent lake connections with the iron ore districts of Minnesota. Chicago is a great central place of exchange for the food products, for coal, iron, and other raw materials, and for a great variety of manufactured goods. Look again at figure 249. Can you not picture thousands of coal cars rolling into Chicago and into factory towns and cities near Chicago? Can you not see millions of hogs, cattle, and chickens carried into Chicago's stockyards each year, and prepared meats shipped out in every direction to other cities on her many railroads? Wheat and corn from Iowa and other Western states are brought by train and boat to Chicago and from here are distributed to other parts of the country. There seems to be no limit to Chicago's hinterland. It extends in every direction, north, east, south, and west, from the great city.

Hinterland and ease of reaching markets, therefore, are important reasons for the location of cities. The transportation arms of

the city reach out into the hinterland, to the farms and mines and forests. They gather in the agricultural products and natural resources, and draw these products to the great city. The city uses some of them, manufactures others into still more special kinds of products, and sends these on by means of other long transportation arms to the far parts of the earth. From these far places it brings back other products, raw materials and manufactured articles, to use itself or to send back into the hinterland.

2. What makes a Good Manufacturing Center?

The point has been made that two chief factors determine a city's location — opportunities for (1) trading and (2) manufacturing. The preceding illustrations have dealt with trading. We must consider now examples of communities that have grown because of favorable conditions for manufacturing.

These conditions can be summed up by saying that manufacturing develops where there are power resources, such as coal and falling water, and also supplies of raw materials — iron, cotton, etc.

The cities we have studied in this chapter have grown not only because of transportation or nearness to markets. Most of them grew because they are *located near sources of power and supplies of important raw materials.* Providence, for example, not only has water transportation but also has water power. Swift-flowing rivers turned the wheels of its spinning and weaving mills in the days when steam power was unknown. Pittsburgh early became a manufacturing community because water power was at hand to propel its machines. The first textile mills in the United States were built in New England, — at Lawrence, Lowell, and other sites, — and always on rivers because of the water power. Minneapolis became a flour-manufacturing center and its mills dotted the banks of the Mississippi River at the great falls, for there power was cheap.

However, although water power is important, you already know that coal is still our main source of power. Near Pittsburgh and the cities around it are great coal mines, which furnish fuel for the factories of those communities.

Wherever coal is found in large amounts, therefore, cities have grown. If you will compare the coal map of the United States

(figure 70, Chapter VIII) with the map of the industrial zone (figure 180), where 90 per cent of our large cities are located, you will find the proof of this statement. In the great anthracite region of Pennsylvania and West Virginia there are scores of communities which owe their existence entirely to the location of coal close by. Consider, for example, the hustling city of Wilkes-Barre, Pennsylvania, with a population in 1920 of 73,000 inhabitants.

FIG. 251. This is a town near Pittsburgh that grew up around a coal mine. (Courtesy of the Consolidation Coal Co.)

Close by are Scranton, with its 137,000, and Hazelton, Pottsville, and several other communities of approximately 20,000 each. A century and a half ago almost nobody lived at these sites.

Today more than 1,000,000 people have crowded together into this section. All through it cities are grouped so thickly that you can hardly distinguish one from another. Why? Chiefly because of the coal that lies in the earth close by. So valuable is it that in many instances, when the coal veins led that way, the miners have dug under the very cities themselves. Meanwhile the life of the city goes on aboveground, in the daylight, over the sweating coal miners who are digging and blasting in the damp darkness hundreds of feet below.

There are other great natural resources, the discovery of which has caused the growth of cities. Consider the communities that have grown up in Minnesota and Wisconsin chiefly because of the presence of iron ore. Hibbing, Minnesota, is a good example. In 1900 its population was only 2,481. The population in 1920 was over 15,000. A dozen iron mines are situated within walking distance of the Hibbing railroad station. Even with no other industry on the Mesabi iron range but iron mining, the wilderness is already being transformed into civilized communities of large towns.

The same rapid growth of cities is occurring because of the oil industry. With its sudden development after 1890, many towns and cities have grown up in our Southwestern states. On the map of figure 252, Tulsa, Oklahoma, is indicated as an example of a city which grew up largely because of the discovery of oil close by. Note the increase in population in several typical oil cities.

City	Population	
	1900	*1926*
Tulsa, Oklahoma	1,390	135,900
Fort Worth, Texas	26,700	161,900
Houston, Texas	44,700	256,000

Throughout the history of our country, therefore, towns and cities have grown wherever important natural resources have been discovered. In each of the gold and silver rushes this happened. Near each of the locations where copper, zinc, and other important minerals were found towns sprang up. Some of them were "boom" towns, — short-lived, flourishing only as long as the gold or silver, copper or oil, lasted. When the resources became exhausted, people began to leave the towns. In some cases towns have been entirely abandoned. Today there are only deserted stores and empty tumble-down buildings to mark the places where such "boom" towns once flourished. They are examples of the fact that when communities depend only upon the presence in the earth of one important natural resource they are likely to disappear when that natural resource has been exhausted.

Other resources besides minerals have attracted people to certain regions and have caused the growth of towns and cities. For example, in early days many communities grew up in heavily forested regions because of the profit to be had in lumbering. In

some states, as in Michigan, Wisconsin, and Colorado, towns grew around factories in which sugar was extracted from sugar beets. In widely separated parts of the nation other communities have developed because of the manufacture of canned foods. Perishable food products like fresh vegetables are often preserved and canned in factories in the farming regions. All these factories must have workers. Thus towns and cities grow. Along certain rivers, like the Columbia in the Northwest, where salmon and other fish abound canning industries have developed. In all our fruit and vegetable sections canning factories have grown up.

INTERESTING READINGS FROM WHICH YOU CAN GET ADDITIONAL INFORMATION

Books

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Articles in this series of particular interest to the pupil are as follows:

A–4. Goode, J. P. What Nature has done for a Tropical City, pp. 41–50.
C–25. Goode, J. P. A Seaport as a Center of Concentration of Population and Wealth, pp. 201–208.
A–24. Lyon, L. S. Concentration of Population in Great Cities, pp. 201–208.

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B–24. Swartz, G. W. Building the Industrial City of Gary, pp. 201–208.

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*Southworth, Gertrude Van Duyn, and Kramer, Stephen E. Great Cities of the United States. Iroquois Publishing Company, Syracuse, New York, 1922.

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*"Chicago Today and Tomorrow — A City whose Industries have Changed the Food Status of the World and Transformed the Economic Situations of a Billion People," *National Geographic Magazine*, January, 1919, pp. 1–42.

*New York — the Metropolis of Mankind," *National Geographic Magazine*, July, 1918, pp. 1–49.

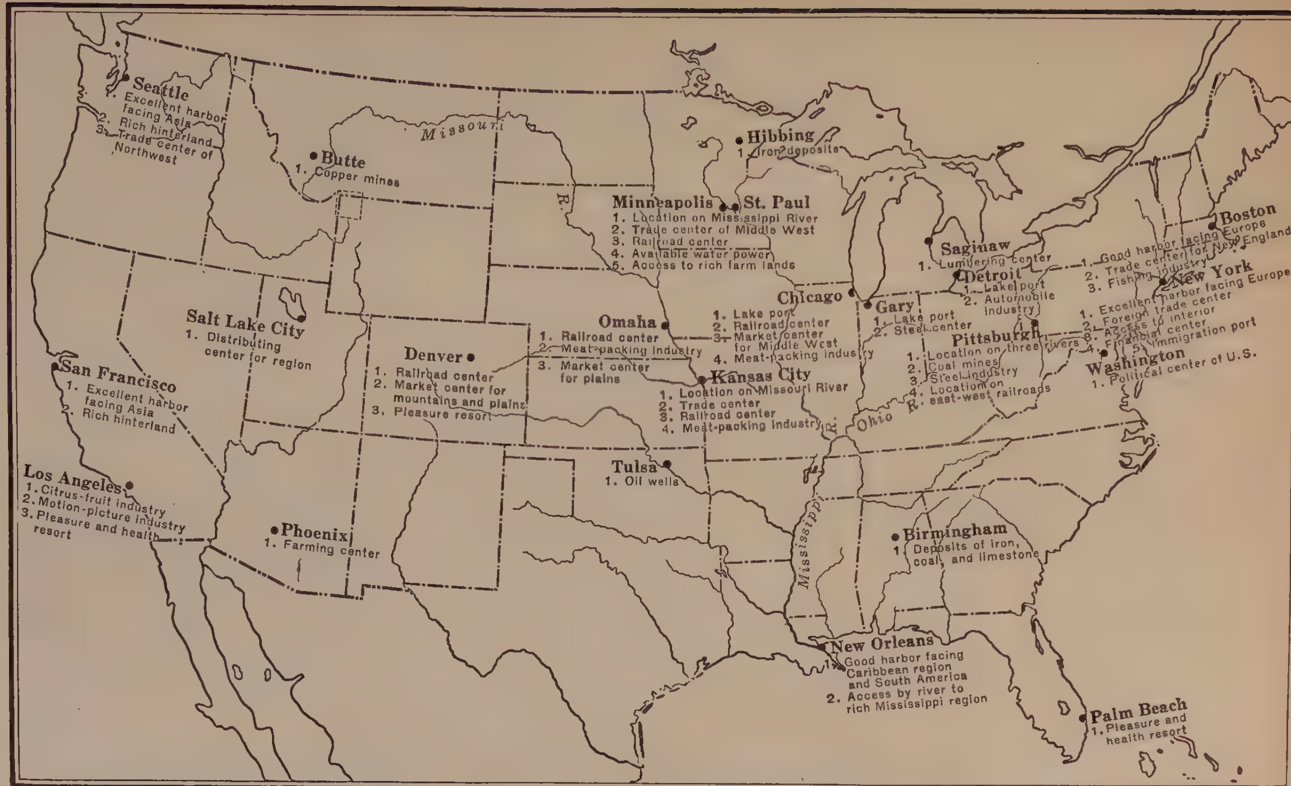

FIG. 252. Chief reasons why some of the cities of the United States grew where they did

BEFORE YOU STUDY THE IMPORTANT PROBLEM OF FEEDING A NATION OF TOWN AND CITY DWELLERS

We have learned that the Industrial Revolution made many changes in the way people live. None is more important than that of the crowding together of people in cities. Although in the history of all countries there have been cities, until the Industrial Age only a small proportion of the inhabitants of a country lived in them; most people lived in villages and towns and worked on farms.

But with the invention of machine manufacturing and swift transportation, more and more people came to work at one place. Thus villages grew into towns, and towns into cities; in a few cities, located very favorably, inhabitants are now numbered in millions. This is true not only of the United States but also of England, of France, of Germany,— of all the countries that have taken up machine manufacturing. In Chapter XXII, therefore, we studied the very important problem of how and why American cities grew up where they did.

The rapid growth of cities after 1800 caused manufacturing countries to face another serious problem: How could city dwellers be fed? They were not engaged in raising food; they were engaged in manufacturing goods, in buying and selling, in transportation, and in the professions. Could food be produced and distributed rapidly enough to feed them? That question will be the problem of Chapter XXIII.

CHAPTER XXIII

CAN THE UNITED STATES, A NATION OF TOWNS AND CITIES, FEED ITSELF?

The Contrast in Farming between 1800 and Today

Plowing in 1800

Daniel Leake lived a little before 1800. He grew up on a farm, on which he obtained all his training for his life work as a farmer. The artist shows him in the upper part of the picture guiding his wooden plow as it is drawn by a team of horses. Farming, as done by Leake, was slow work. The plow tugged and jerked at his arms

Fig. 253. This picture illustrates the old and the new way of farming; the horse-drawn plow and the engine-driven plow. (Courtesy of *Farm Machinery and Hardware*)

as he strove to keep it in an even furrow. His shoulders were tired; his legs were tired. It was a long way back and forth, back and forth, across the field. Daniel Leake was not the only farmer who had to trudge behind a plow all day. All his neighbors did the same thing. Indeed every farmer of Leake's day, wealthy enough to own a horse, used the same methods of breaking up the soil. Those who were poorer than Leake used only their own muscles, unaided by animal power. Plowing was certainly slow and farms were small in 1800.

Plowing today

Thomas Campbell grew up on a farm, too, more than a hundred years later than Daniel Leake. In the lower part of the picture (figure 253) you see him comfortably seated on his gasoline tractor, guiding a modern steel plow. The tractor and the plow do most of the work which the muscles of horses and farmers like Daniel Leake formerly did. Campbell's education, however, was very different from that of Daniel Leake and his neighbors. He went to an engineering school to learn how to farm. He explained his reason for doing this, saying: "If there is any place in the world where we need engineering, it is on the farm! Man power and horse power are weak and insignificant. We must have speed and greater power. That means machinery. I'm going to study engineering as a preparation for farming."

The comparison of the way in which Leake and Campbell plowed illustrates but one of the amazing changes that have come in a century in farming.

Campbell's machines prepare a strip of ground twelve feet wide as they go. In a day they get a piece of ground three miles long and 132 feet wide ready for seeding. In addition to plows, his tractor draws other machines as well. Some of these machines will completely prepare the soil for growing crops and will even plant the seeds. In the meantime the farmer merely guides these machines which help him to do his work. Leake could not have cultivated a plot of ground three miles long and twelve feet wide in a day even with a dozen men and a dozen horses to help, for he lacked the machines that today do most of the work.

In farming, however, just as in manufacturing, machines,

FIG. 254. This is a modern plow drawn by a gasoline tractor. It plows four furrows at once. (Courtesy of the American Agricultural Chemical Co.)

although a substitute for muscles, are not a substitute for brains. The farmers today who use agricultural machinery have to understand their machines to be able to use them intelligently and to keep them in good working order. The reason is that now many agricultural colleges have departments of engineering. In these colleges the young farmers also learn how modern science is revolutionizing farming.

A revolution has come in agriculture as in other industries

Let us study another example of the change that the Industrial Revolution has made; namely, that in agriculture. To illustrate it we shall take the harvesting of grain.

BEFORE THE INVENTION OF POWER-DRIVEN MACHINES GRAIN WAS REAPED BY HAND WITH THE SICKLE, THE SCYTHE, AND THE CRADLE

For many thousands of years farmers cut their grain with hand tools, like those which we call sickles. They were very crude tools indeed. The blades of the primitive sickles were made of flint, of bone, later of bronze, and finally of steel. Their handles were short, so that in cutting grain a man was compelled to stoop low at his work. With such a tool several days were required to cut a single acre

FIG. 255. This is a hand sickle which people today use only in trimming lawns around their houses. Your forefathers used a sickle to cut hay before they had better farming tools

of wheat. (How much success would an Iowa or Illinois farmer today have in trying to reap a thousand-acre wheat farm with one of those hand sickles? Could the hungry millions of our cities and towns be fed if our farmers were compelled to depend upon such tools?)

Fig. 256. These men are cutting hay with scythes. With a scythe one man can mow three acres a day. (Courtesy of the American Agricultural Chemical Co.)

Then came an improvement through the invention of another reaping tool, called the *scythe*. This consisted of a much longer knife attached to a long handle. It was possible for this tool, the scythe, to be swung by a man standing up and using two arms instead of one, so that in this manner he could cut a much larger swath.

Later improvements were made in harvesting tools; for example, the *cradle* (figure 257) was invented and used widely in the American colonies before the War of the Revolution. This reaping tool was an improvement on the scythes formerly used. In addition to the long cutting knife it included several thin wooden strips above it, on which the grain was caught as it was cut. Instead of dropping to the ground as it formerly did, the grain could now be gathered as it was cut. The cradle made it possible for one man to harvest as much as three could harvest formerly with the older kind of scythe.

Fig. 257. The cradle, an improvement over the scythe, enabled farmers to cut and gather a wide swath by the full swing of their arms

The scythe and the cradle were improvements over the sickle. They are still used where farms are small and in special places where the gasoline tractor cannot go. Men no longer had to stoop, bent double, while they harvested their grain. Even with the cradle, however, the harvesting of crops depended altogether upon the farmer's muscles. All through our colonial history and during the first half-century of our national history the soil was plowed and crops were reaped by such hand tools.

The First Reaping Machine, 1831

After 1800, as you have already learned, engines and machines were changing manufacturing and transportation. At the very moment when George Stephenson, Peter Cooper, and others were inventing the first successful locomotives, a young mechanical genius by the name of Cyrus W. McCormick was working on a machine that would take the place of the harvesting tools — the sickle, the scythe, and the cradle.

Fig. 258. The first hand-made McCormick reaping machine was shown in 1831. It was this machine which started the revolution in agriculture. (Courtesy of the International Harvester Company)

One day in 1831 a crowd of people gathered on an Ohio farm to watch McCormick exhibit a clattering, strange-looking machine, drawn by four horses. The crowd looked on, filled with curiosity, many of them laughing and jeering at McCormick as others had laughed at Kelly blowing air through iron, and at Morse and his electric telegraph. Perhaps in the hearts of some was the hope that the machine would not work, lest it should take from them their jobs as farm hands.

But it *did* work — not very well, to be sure, for the ground was hilly; but *it worked.* It cut the grain so irregularly, however, that

the owner of the field rushed up and shouted, "Here! This won't do! Stop your horses! Your machine is rattling the heads off my wheat." But the demonstration of McCormick's machine went on successfully, for just then another farmer rode up on horseback.

Fig. 259. McCormick and other inventors improved reaping machines. This shows a machine built by McCormick in 1875. (Courtesy of the International Harvester Company)

"Pull down the fence and cross over into my field," he said to McCormick. "I'll give you a fair chance to try your machine."

This was done, and in a more level field McCormick reaped for several hours what seemed to the onlookers a tremendous amount of grain for that amount of time.

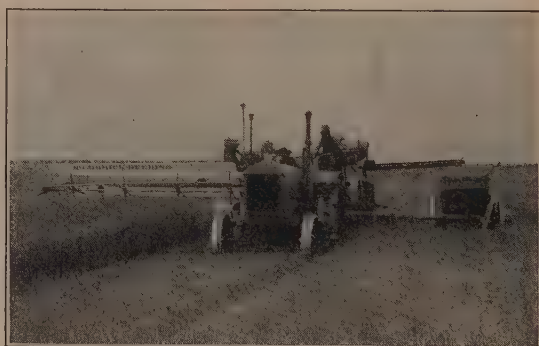

Fig. 260. This is one of the most modern harvester-threshers. It cuts a 24-foot swath of grain, harvests it, threshes it, and delivers it into the steel wagon at the side while the machine travels across the field. (Courtesy of the International Harvester Company)

McCormick's first reaper of 1831, although crude in construction, was made on the same principles as are the efficient harvesting machines of today. The improvements in the machine came steadily. Every inventor who worked upon it added some new idea that saved human labor. For example, one improvement consisted of a device that raked the grain as the knives cut it. Another device gathered it on a platform. Later, another bound it into bundles.

Space is lacking to give pictures showing all the stages through which the harvesting machine passed before it became what it is today. For more than sixty years after the first McCormick machine, animals were still used to pull the reapers. Then came the invention of the gas engine and its application to many kinds of work. You have learned how it revolutionized road transportation by making possible the automobile; how it transformed air transportation by making possible the heavier-than-air plane. Practically at the same time, in the 1890's and early 1900's, it was used in machine agriculture in the form of the gasoline tractor (see figures 253, 254, and 260). The picture of figure 260 shows the "latest word" in harvesting machinery — one machine which cuts grain, gathers it, threshes it, and deposits it in a wagon, and all done as the machine moves across the field.

This is only a brief outline of the way in which harvesting machines replaced the sickle, the scythe, and the cradle. Had we sufficient space, we could relate a similar story for the change that has come in the *cultivating* of crops. The contrast in plowing was illustrated at the beginning of the chapter, in the reference to the way in which Leake and Campbell plowed. Today the catalogues of the manufacturers of agricultural machinery advertise scores of machines to aid the farmer in carrying on every aspect of his work. There are electric milking machines, pulverizers, corn-planters and cotton-planters, grain-drills, grain-binders, grain-headers, corn-headers, corn-binders, potato-diggers, and broadcast seeders; there are also machines that prepare crops for the market or for farm use, such as ensilage-cutters, corn-shellers, hay presses, feed-grinders, and cream-separators. Farming today depends on these machines.

Today the United States is the World's Greatest Farming Country

What were the results of the widespread use of machines on the farms in the United States? The results can be summed up briefly in such facts as those given in the table on the next page.

Of course there are other important reasons in addition to the increasing use of machines for the fact that we produce such a

large share of the world's food. In Chapters III and IV you learned of two of them; namely, our large acreage of fertile soil and the favorable climate. It is a fact, however, that with only 5 per cent of the earth's land surface within the boundaries of the United States, and only 6 per cent of the people, we produce much more than our proportionate share of the world's foodstuffs. There are several other great agricultural countries in the world. For example, Russia, China, India, and Argentina are great, but the United States produces more food than any one of them. Indeed the whole British Empire, comprising India, Australia, New Zealand, South Africa, Canada, and the British Isles, produces only nine tenths as much food as the United States.

In 1920 the United States produced

70	per cent of the world's corn
25	per cent of the world's oats and hay
20	per cent of the world's wheat
13	per cent of the world's barley
7	per cent of the world's potatoes
5	per cent of the world's sugar

The products in the table on this page comprise only a small proportion of all the products of our farms. If the list were complete, we should also include animals and animal products, such as cattle, sheep, swine, horses, poultry, meat, hides, wool, butter, cheese, milk, and eggs; vegetable products, such as cottonseed oil, flour, feed for cattle, and garden vegetables; also fruits and nuts.

The average American has not only a large supply of food but also a great variety of things to eat. The American people probably have a more varied diet than any other people in the world. Not only is the United States the greatest producer of agricultural commodities, but it also exports more of them than any other country. In the years following the close of the World War our farmers exported more agricultural products than all other countries of the world combined. At the same time, our people were practically fed by our own farms.

BETWEEN 1790 AND 1920 WHAT CHANGES HAVE TAKEN PLACE IN THE POPULATION OF THE UNITED STATES?

Here are some important facts regarding the population of our nation:

1. The *total* population of the United States increased from approximately 4,000,000 in 1790 to 105,000,000 in 1920, or more than 26 times.

2. The *rural* population increased from 3,800,000 in 1790 to 51,000,000 in 1920, or 14 times.

3. The *urban* population increased from 130,000 in 1790 to 54,000,000 in 1920, or 400 times.

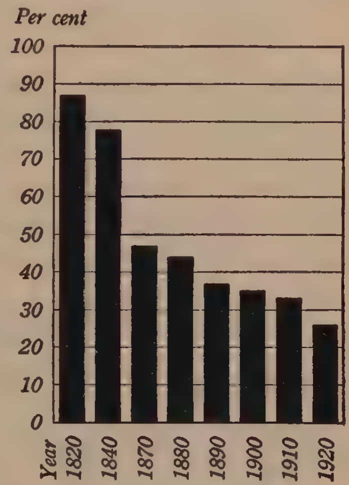

FIG. 261. This illustrates the decrease in the per cent of farmers in the United States between 1820 and 1920

What conclusions can we draw from these facts?

First, that the number of people in the United States has increased rapidly.

Second, that the most rapid increase in population between 1790 and 1920 was in urban districts. This increase in urban regions was much more startling than that in rural areas.

Third, that in 1790 over nine tenths of the American people lived in rural districts; in 1920 less than five tenths of the people resided in rural areas.

Figure 262 sets forth the growth of the city population and the decline of the rural district in another way. It shows what per cent of the entire population in the United States was living in urban and rural districts from 1790 to 1920.

In 1790 there was not a single city in the United States larger than 50,000. In 1920 there were

3 cities larger than	1,000,000
9 cities larger than	500,000
56 cities larger than	100,000
218 cities larger than	25,000

The United States is, indeed, a country of cities and towns. There are small manufacturing towns, villages on the border of farming

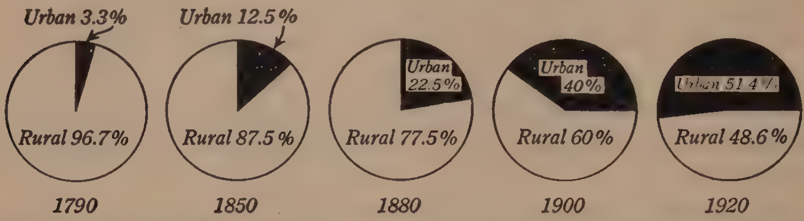

FIG. 262. How the urban (city) population grew between 1790 and 1920. The graph shows the per cent of the American people living in urban (cities of a population of 2500 or more) and rural districts

districts. There are suburban towns where workers in the city dwell. There are county seats, oil or automobile towns, college towns, railroad-shop towns, retired-farmer towns, port towns,

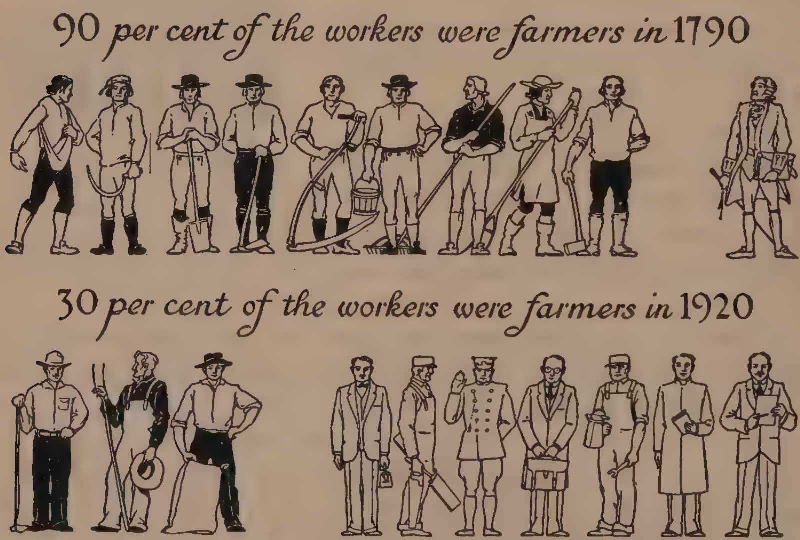

FIG. 263. This compares the approximate per cent of the total working population in the United States engaged in farming in 1790 and in 1920

fishing towns, lumber towns, and mining towns. Nearly every kind of community known to man can be found somewhere on the broad territory of the United States. So the populations of towns and cities have grown more rapidly than those of farming districts.

Figure 263 puts the matter in another way; it compares the *per cent* of workers in 1790 and in 1920 who were farmers; namely, 90 per cent in 1790, 30 per cent in 1920.

But it is not only the *proportion of rural population* that is growing smaller; *in some states the actual number of farmers is growing smaller.* Nevertheless the smaller number of farmers is producing more farm products than were produced before! Figure 264 sums up what happened in Illinois, Iowa, and Missouri between 1900 and 1910. In these ten years the number of farmers actually decreased from 1,261,000 to 1,225,000. At the same time, however, the amount of corn, wheat, and oats produced in these states *increased* from approximately 5,000,000,000 to approximately 6,000,000,000 bushels; that is, the number of farmers *decreased* 3 per cent, but the amount of grain they produced *increased* 20 per cent.

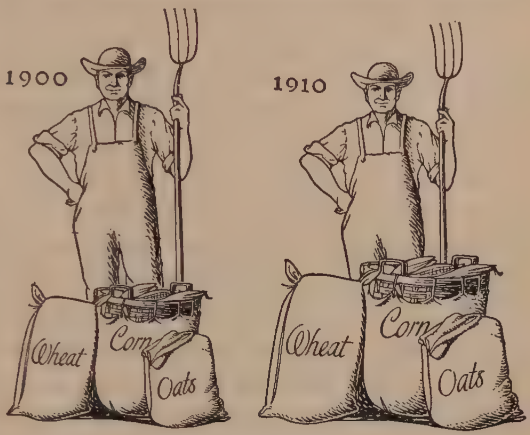

FIG. 264. A tale of three states, Illinois, Iowa, and Missouri. The lower height of the farmer in the right graph and the greater height of his bags of wheat, corn, and oats portray the results which were obtained by the increased use of farming machines and more scientific methods between 1900 and 1910. The number of farmers decreased 3 per cent, but the amount of the product increased 20 per cent in three states

ONE REASON FOR OUR LARGE AGRICULTURAL PRODUCTION

The rise of agricultural machines has brought about "specialization" and "mass production" in farming as it did in manufacturing

Another striking change has come about in the last century in farming. There has been a change not only in the way the farmer farms but also in the number of products which he raises. A century or so ago the frontier farmer produced on his own farm

most of the articles he needed for his family and for carrying on his farm work. One such farmer who lived shortly before 1800 wrote: "At this time my farm gave me and my family a good living in the produce of it and left me one year with another hundred and fifty silver dollars, for I never spent more than ten dollars a year, which was for salt, nails, and the like. Nothing to eat, drink, or wear was bought, as my farm provided all." He was almost self-sufficient. He produced only for his own use and for the use of others in his immediate neighborhood. This means that he raised his own wheat, vegetables, fruits, and all the live stock — the horses, cows, pigs, and chickens — for his family.

Today, however, most farmers *specialize* much more than did the pioneer. They devote themselves altogether to farming, and many of them to producing one or at most a few kinds of agricultural products. Today there are thousands of farms on which wheat is the chief crop raised. Similarly, there are corn farms, cattle ranches, pig and poultry farms, truck farms, fruit farms, and dairy farms. It is by specializing on one or on a few products that a farmer learns how to produce great quantities of products more cheaply and more easily. With all the scientific knowledge that he can gather he studies how to make his farm produce the largest crops for the smallest outlay.

As manufacturing has increased and also become specialized, the farmer has stopped making the other articles that he needs. He sells his wheat, corn, beef, dairy products, or whatever other produce he raises, and with the money which he receives buys from the city manufactured goods or such other products as his farm does not supply. In Chapter XII we studied examples of specialization in the manufacturing industries. Here we find another important form of specialization. The manufacturer manufactures, and the farmer farms; but the manufacturer usually makes only a few articles, and the farmer produces only a few kinds of food.

With the foregoing examples, we have completed our brief story of the amazing changes that have come about in farming. Whereas a century ago only small amounts of food were produced, and only by great physical labor, today large quantities of food are produced with much less labor. The use of power-driven

machines, specialization, and better methods in farming have brought about mass production in agriculture. Scientific methods have been applied to farming.

Other Important Reasons for the Large Agricultural Production of the United States: Much Fertile Soil and a Favorable Climate

In our study of American civilization we must not forget that the United States is both a manufacturing country and a farming country. We must remember that although more than 54,000,000 of its people live in cities and towns they do not have to depend on other countries for their food; most of it is supplied by American farmers.

The invention of power-driven farming machines and the use of scientific ways of farming alone, however, could not have transformed a small country of farmers into a large country of city and town dwellers. In addition to machines and specialized scientific farming, large areas of fertile soil located in a favorable climate were necessary.

If tractors and seeders and harvesting machines were sent to the people who live in frigid Iceland, would they be able to raise wheat and corn to help feed the world? If the tribes who live on the Arabian or Sahara deserts had farming machinery, could they produce the world's food with it? Would farming machines and scientific knowledge enable the people who live on mountains like the Rockies, the Andes, or the Himalayas to raise much food for the people of other regions?

No! Nearly five sixths of the world's land area is useless so far as agriculture is concerned. It is too cold, too dry, too wet, or too steep and rocky for crops.

Four things must be true of a country or a region if it is to feed itself and also help to feed the rest of the world.

It must have

1. A large amount of fairly level land.
2. The right kind of soil.
3. Sufficiently long seasons of warm, sunshiny weather.
4. The right amount of rainfall each year.

1. Has the United States a large amount of fairly level land?

The relief map of figure 265 helps us somewhat to answer this first important question. It reminds us that between the Rocky Mountains and the Appalachians there is a great domain more than a thousand miles square in which there are almost no mountains. The western part of this region, that covered by the

Fig. 265. Relief map of the United States. Note the large area of relatively level land between the Rocky Mountains and the Appalachian Mountains; also the fairly large area of relatively level land southeast of the Appalachian Mountains

states of Montana, parts of North and South Dakota, Wyoming, Colorado, and Mexico, and a part of Texas, consists of a high plateau. Although its altitude is from 3000 to 5000 feet above sea level, much of this vast region is level. Throughout the remainder of the central plains, however, the land is not only level but much lower. Over much of this area the altitude is from 500 to 1000 feet. From Ohio westward through Indiana, Illinois, and Iowa are thousands of square miles of level or slightly rolling land. As far as the eye can reach in the summer months there are fields of waving corn and wheat.

The vast region from the Appalachian Mountains to the Rocky Mountains and from the Gulf of Mexico to the Great Lakes is one of the most wonderful farming areas in the whole world. Only the

broad, level plains of the central and eastern European countries are even approximately as good.

If at this point you compare the map of figure 265 with the map of figure 268, you will note that this level region is indeed the grain-producing section of the United States. Here are the great corn and wheat belts, and it is on level lands that the foods on which we depend are most easily cultivated.

Note furthermore that the extreme Southern and Southeastern states are also covered largely by low, level land. Most of the land of eastern Texas, Louisiana, Mississippi, Alabama, and Georgia is also suitable for farming. It is low, the altitude averaging less than 500 feet above sea level.

Of course there are farms even in the mountains. Throughout hilly New England much of the land is cultivated. In the Appalachians are hundreds of little hilly farms. Even in the Rockies, the Sierra Nevada, and the Cascade Range, farming of a kind is carried on. Hence, we must not be misled by the appearance of the relief map to conclude that there are farms only in the central and Southeastern plains. We should remember, however, that as far as the first question is concerned, we can answer emphatically: the United States has a large amount of fairly level land.

2. Has the United States much fertile soil?

Not only must a country have large amounts of fairly level land to produce great quantities of food, but in addition the land must be *fertile*. That is, it must contain the kinds of food upon which plants grow. It must be located where there is enough sunlight and rainfall, where there are long growing-seasons. Let us ask first, therefore, does the farming land of the United States contain the right kinds of plant food?

You know, of course, that agricultural plants, such as corn, wheat, hay, and oats, will not grow upon rocks, nor will they grow well upon sand, gravel, or clay. They will grow, however, upon a combination of clay and sand and decayed vegetable matter called *humus*, which acts as a fertilizer. For such plants to grow abundantly several chemical substances should be contained in this combination. Three of these — magnesium, iron, and

sulphur — are found in almost every place where land is used for farming. Others which are also necessary to produce the best crops — calcium, phosphorus, potassium, and nitrogen — are often absent.

Until recent years farmers cultivated the soil without much knowledge of the substances which it contained. From experience in farming they learned to tell from the way the soil looked whether it would raise good crops. In the past fifty years, however, science has helped the farmer as it has helped the manufacturer. Scientists have learned how to test the soil to discover which chemical substances it contains and which ones are absent. The scientists have also learned how to prepare fertilizers which contain the substances that a farmer's land needs. In recent years the fertilizers which contain different combinations of chemical substances have been manufactured by commercial companies.

Fig. 266. This shows a rich potato harvest in Maine. (Courtesy of the American Agricultural Chemical Co.)

Thus we see that modern science has not only given the farmer machines but is also teaching him how to transform poor soil into good soil. It not only has lightened his labor but has taught him how he can get from it more products for his work. Look back at figure 264. Is the meaning of this pictograph clearer now?

The foregoing paragraphs have told us, therefore, what a fertile soil is and how an infertile one can be fertilized so as to grow good crops. We return to our principal question: Has the United States much fertile soil?

The Department of Agriculture through its Bureau of Soils makes surveys of the farm land and studies the character of soil. This bureau has surveyed in detail 684,451 square miles — an area equal to the combined areas of Norway, Sweden, France, and Germany. Such surveys have shown our rich resources of fertile soil. There are many kinds of soils, and some are suited to one kind of farming, some to another. In 1928 the Department of Agriculture estimated that there were 1,250,000 square miles of land that could be farmed. At present we cultivate only a little more than half of this. In order to use the rest of the fertile soil, some of it would have to be irrigated, some drained, and other parts cleared of forest. But all of it *could* be cultivated.

3. Do the farming sections of the United States have sufficiently long seasons of warm, sunshiny weather?

But to produce large crops a fertile soil must be located where there is enough warmth and sunlight — that is, where the growing seasons are of the right length. Some crops, as wheat and corn, for example, require long seasons of very warm weather, for they grow slowly. Other crops ripen very quickly.

Consider a few examples. Corn requires a long season of uniform high temperature. No corn is grown where the average temperature in the daytime is less than 66° or where the average night temperature is less than 55° in the three summer months. Furthermore, the growing-season must be approximately 145 days, varying for the different kinds of corn from 90 to 180 days. If you will compare figure 267 with figure 268, you will note that most of the corn produced in the United States is raised in a central region where the growing-season averages about 140 or 150 days.

Consider wheat as another example. There are two kinds of wheat. One kind is called spring wheat. It will grow in a season of warm weather of about 100 days. Winter wheat, on the other hand, requires a growing-season as long as 150 to 180 days. In this case also the map of figure 268 shows the spring-wheat and winter-wheat regions to be located where growing-seasons are approximately of those lengths.

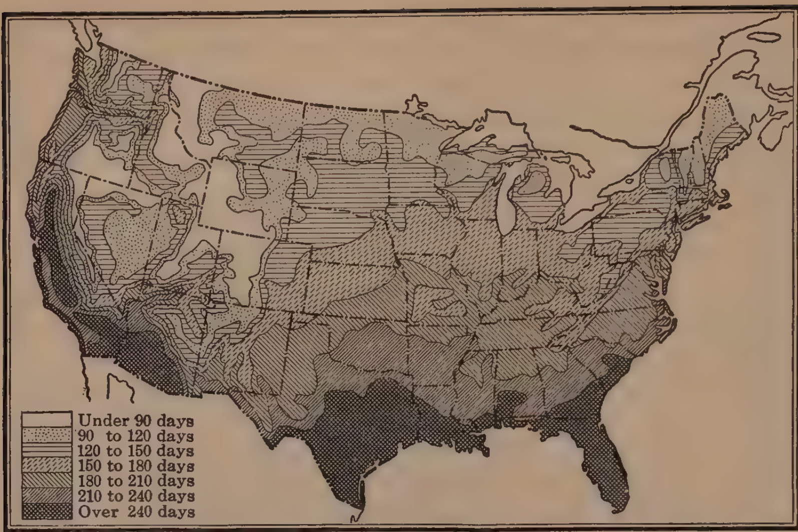

FIG. 267. This map shows the average number of days in which weather is favorable for the growing of crops. The United States Department of Agriculture, which made the map, shows the average length of growing-seasons in the United States. In which region is the growing-season longest? shortest? of medium length? This map should be compared with that of figure 268

FIG. 268. This map shows the regions where the chief crops are grown

As a third example, consider the citrus fruits — grapefruit, oranges, lemons, and limes. These fruits need very long seasons of hot, even temperature. Grapefruit, for example, is so sensitive to cold that even a few hours of too low a temperature will kill the growing fruit. Figure 267 will help you to understand why it is that many of our citrus fruits come from Florida, Texas, and California. It is here that the growing-season is longest — over 240 days. Even in the parts of those states which seem ideally suited to these sensitive fruits, farmers have to guard against short intervals of cold weather. At such times they are even prepared to light smudge fires in their orchards on cool nights, so that a smoke blanket may keep the warm air near the earth from rising and being replaced by cold air.

The foregoing illustrations and the maps of figures 267 and 268 give us the answer to the third question. The United States is fortunate indeed in being located in the north temperate zone, where growing-seasons are of proper length to permit the raising of a great variety of crops.

4. Do the farming sections of the United States have the right amount of rainfall?

To this point we have considered three of the conditions that must be true of a country if it is to feed itself and help to feed the rest of the world: (1) large amounts of fairly level land, (2) fertile soil, (3) sufficiently long seasons of warm, sunshiny weather. We have learned that the United States is fortunately situated with respect to each of these conditions. But these three alone would not account for the fact that it has become the world's greatest farmer. There is a fourth condition; namely, appropriate amounts of rainfall. To produce large crops, not only must the land be fairly level and fertile and the temperature warm, but these conditions must be combined with appropriate amounts of rainfall in order to produce the important foods upon which people depend.

Figure 270 shows that in this respect also the United States is fortunate. The eastern half of the United States has from 20 to 60 inches of rainfall a year, the central part of this area averaging approximately from 20 to 40 inches, and the eastern part

FIG. 269. A fine growth of corn produced by scientific methods of farming under favorable conditions. (Courtesy of the American Agricultural Chemical Co.)

from 40 to 60 inches, with small regions of even more than 60 inches. The western half of the United States, including the great plateau and the Rocky Mountain section, averages only from 10 to 20 inches. However, in the northern part of the western coast rain falls in very large amounts, averaging more than 60 inches per year.

Thus we see illustrated again the outstanding importance of the location of the United States on the earth. In Chapter III we learned that the amount of rainfall in a particular region

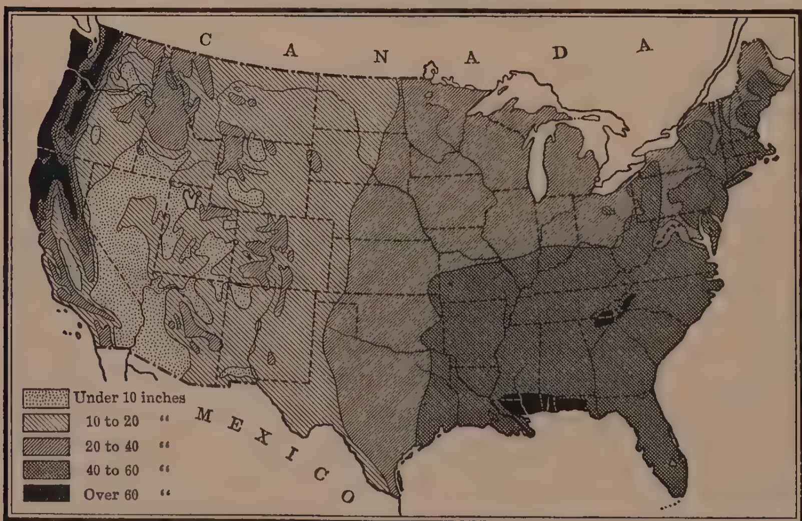

FIG. 270. The map shows the average number of inches of rainfall in a year in different sections of the country. The dotted regions on the map have less than 10 inches; those shown in black have more than 60 inches

depends upon the character of the winds and whether the land is mountainous or relatively level. Perhaps it would be well for you at this point to read again rapidly the discussion of this problem in Chapter III. It will serve to remind you that the United States is fortunately located with respect to rainfall as well as temperature and soil. In the next chapter you will learn that in the different regions of the United States the amount of rainfall varies, but it is sufficient to produce a wide variety of crops and to permit many kinds of farming.

Modern People have relearned and improved on Something Ancient Peoples knew; namely, Land Irrigation

Throughout this book we have learned that scientists have acquired knowledge which enabled man to change many of his ways of living. For example, scientific knowledge led him to invent engines and machines which have transformed manufacturing, transportation, and communication, and thereby improved greatly his standard of living. We have just learned that scientific knowledge enabled him to improve the soil, so that land hitherto unsuitable for farming could be made to produce fine crops. We are prepared to learn, therefore, that in still another manner science has improved farming; namely, in bringing water to regions where there is relatively little rainfall. We call this *irrigation*. In earlier civilizations people knew how to build dams and reservoirs and to dig canals or build aqueducts by which water could be brought to dry regions. We have already learned that the Egyptians irrigated much of their land. They and other peoples who practiced irrigation, however, did it by very crude methods. Modern science, on the other hand, has made it possible for engineers to build still greater dams and to construct aqueducts of steel and concrete by which water can be carried even hundreds of miles to regions where there is little rainfall.

If you will turn to figure 268, you will note the region in which the largest amount of irrigation has been carried on; namely, the Rocky Mountain and plateau sections. Now if you will compare that map with the map of figure 270, you will also note that this is the region in which rainfall is light, averaging through-

out most of its area less than 20 inches per year. In the southern portion of this region there is much desert land, the soil of which is exceedingly fertile. Men have learned recently that by irrigating this soil abundant crops can be grown upon it; hence in a number of places in that section the rivers have been dammed to hold back the water which comes down from the mountains in the spring. Then in the later dry seasons this water is used to

FIG. 271. Land like this would be worthless were it not for the irrigation ditches which you see in the picture. (Courtesy of the Bureau of Reclamation, United States Department of the Interior)

irrigate the land. Canals and pipe lines from the dam have been built; these distribute water (see figure 271) throughout many parts of this formerly dry section.

SUMMARY: HOW CAN THE UNITED STATES, A NATION LARGELY OF CITY AND TOWN DWELLERS, FEED ITSELF?

We are ready now to summarize concisely the facts which we have brought together to answer this question.

1. In the United States we have a remarkable combination of circumstances. *First,* in 130 years our country grew from a small population of 4,000,000 to a large population of 105,000,000. *Second,* although in 1790 there were 90 per cent of the people en-

gaged in farming, in 1920 only 30 per cent farmed. *Third*, in spite of the large increase in the number and proportion of city dwellers, the farms of the United States have continued to feed generously the people of the United States. *Fourth*, in recent years, in addition to feeding itself, the United States has exported great quantities of food to other countries.

2. This great production of agricultural crops has been made possible by another combination of circumstances: *first*, the fortunate location and character of our land; *second*, the increase in scientific knowledge. We have learned that (1) the United States includes one of the most remarkable level plains in the world; (2) much of the soil of this plain is sufficiently fertile for farming; (3) this level plain spreads over a vast region in the north temperate zone in which the temperature and the growing-seasons are appropriate for raising the chief food stuffs needed by human beings; (4) over the eastern half of this agricultural plain rain falls each year in amounts sufficient to irrigate the soil properly.

3. We have learned also of new ways in which scientific knowledge has changed man's ways of living. It has made possible the invention of engine-driven machines which have increased many times the quantity of food stuffs that a single farmer can produce. Thus it has released from the farms millions of workers who have gone into towns and cities to engage in manufacturing, trade, and other kinds of work.

4. Scientific knowledge has also made possible the testing of soil, the discovery of the kinds of crops for which different soils are best fitted, and the preparation of artificial fertilizers by which the fertility of soils can be increased.

5. Finally, science has made possible the construction of great dams and reservoirs, the carrying of water over great distances, and the irrigation of soil which hitherto could not be used for farming.

Today the farmer looks to science to help him out in most of his problems just as does the manufacturer. Because of this, agricultural colleges are found throughout the United States.

It is in the fortunate combination of natural resources and scientific knowledge, therefore, that the answer to the question asked in this chapter is found. It is these two things working to-

gether that have made it possible for about 12,000,000 American farmers to feed not only the people in the United States but some of the peoples in foreign countries as well. A nation with more than 54,000,000 city dwellers, not one of whom is producing food from the soil, is fed by a small army of farmers who have learned to use machines and scientific methods.

INTERESTING READINGS FROM WHICH YOU CAN GET ADDITIONAL INFORMATION

Books

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Interesting and easy to read. See Chapter VIII (Cyrus McCormick and the Invention of the Reaper).

BENGSTON, N. A., and GRIFFITH, DONEE. The Wheat Industry. The Macmillan Company, New York, 1915.

A good supplementary reader, including many excellent pictures and maps.

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Chapters I, II, III, XXXI, and XXXII have detailed accounts of the raising of America's staple foods.

*DE KRUIF, PAUL. Hunger Fighters. Harcourt, Brace and Company, New York, 1928.

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Every student will find this atlas of great assistance as a reference book and as a source for supplementary maps.

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*GABRIEL, RALPH HENRY. Toilers of Land and Sea (Volume III of The Pageant of America). Yale University Press, New Haven, 1927.

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"Electric Farming on the Increase," *Literary Digest*, January 30, 1926, pp. 19–20.

"Have we Food to Feed our Immigrants?" in *Scientific American*, February, 1926, pp. 77–79.

*"How the World Is Fed," *National Geographic Magazine*, January, 1916, pp. 1–110.

"Nature is Lovelier because Burbank Lived," *Literary Digest*, May 1, 1926, pp. 44–52.

A story of how a scientist, Luther Burbank, improved the food of the people of our nation.

*"Science Invades the Farm," *Scientific American*, July, 1926, pp. 23–25.

*"Uncle Sam — Spendthrift, VIII. Our Virgin Soils were formerly Rich in Plant Food. We have been taking This Food Out and putting very Little Back, thus exhausting the Soil," *Scientific American*, March, 1927, pp. 170–171.

*"Uncle Sam — Spendthrift, IX. Neglect causes 200 Million Dollars Yearly Loss by Soil Erosion," *Scientific American*, April, 1927, pp. 237–239.

UNIT VII

WHERE THE AMERICAN PEOPLE LIVE AND WHY THEY LIVE THERE

CHAPTER XXIV

THE CHIEF SECTIONS OF THE UNITED STATES

Even as long ago as colonial times many visitors from Europe, and some of the colonists as well, were convinced that the people living on the narrow eastern seaboard of North America would never become one united nation. How could that happen, they argued, with such differences in ways of living, in work, and in interests among the colonists of the various sections? The climate and the soil of the northern and southern sections were different. The interests of the people were different. Most of the Southerners, for example, made their living by raising tobacco and cotton. The Northerners, on the other hand, made theirs by fishing, by trade, by farming, or by handicrafts. Differences in the way they earned their living caused differences in the way they felt and thought. Furthermore, it took several weeks to travel from Massachusetts to Virginia. Communication between the two sections was difficult and slow. The people probably knew less of each other than you do of China today. So, at the very beginning of American history, the climate, the soil, and the lay of the land (that is, its mountainous or relatively level character) caused the people to live separated from each other in "sections."

But these early prophecies that our people would divide up into several countries were incorrect, as you know. For today we are a nation many times larger than the original thirteen colonies. Although our 48 states are scattered over a vast territory, they are firmly bound together by ties of transportation and communication. They comprise one nation: the American People.

Nevertheless, we are even today a nation of many sections and many different interests. This fact is largely the result of differences in soil, in climate, in the lay of the land, and in mineral resources.

First, take the matter of differences in soil. In some large sections, such as the Northeastern states which form the section

known as New England, the soil is sandy, even rocky. Fruit and hay will grow there abundantly, but wheat and corn will not. In other sections, as in the central plains from Ohio to Kansas, the soil is fertile loam, on which can be raised plentiful crops of wheat and corn.

Second, consider the differences in climate, that is, in rainfall and temperature. Some sections of our country, as in the states bordering the Gulf of Mexico, average from 60 to 80 inches of rainfall a year; other sections, like those in the California-Arizona desert, have less than 10 inches per year. The same contrast is found in temperature. In the Northern states temperature changes from warm to cool, and sometimes from very cold to very hot. In other states, as in the extreme South, the temperature is almost uniformly hot. In some sections snow falls nearly half the year, while in others it never falls at all.

Third, contrast the differences in lay of the land, particularly in the height of the land above sea level in different sections. In some sections, as in parts of that section including the Rocky Mountains and the plateau beyond, the land stands from 5000 to 10,000 feet above the sea level. In the great central plains of the Mississippi Valley it averages not more than 500 feet. There are other large stretches of territory, especially on the coastal plains, in which the land barely rises above the level of the ocean. There are still other small areas where the land lies below that level.

Fourth, compare different sections of our country in regard to the supply of mineral resources. Some states, like Pennsylvania, Ohio, and West Virginia, have valuable deposits of coal. Others, like Minnesota and Wisconsin, contain the world's greatest iron-ore mines. Still others, like southern California and the Southwestern states, have rich lakes of oil beneath the surface of the earth. Then there are other sections in which no coal, iron, or oil at all can be obtained.

It is clear, therefore, that there are fundamental differences between various sections of the United States — differences in climate, in soil, in lay of the land, and in supply of mineral resources. Is it not natural, therefore, that the life of the American people is different in the different parts of the United States? Because that is true, it is of the utmost importance that we shall

understand clearly into what geographic sections the United States naturally divides itself. In this chapter we shall study these sections carefully. Where the American people live and why they live there will be our next problem.

The Chief Sections of the United States

The geographic sections into which the United States is naturally divided are seven in number, as follows:

1. The chief industrial section (sometimes called the industrial zone) including New England and the states north of the Ohio River and east of the Mississippi (see maps, figures 272–273).
2. The "New South," including the states south of the Ohio River and east of the Mississippi, and parts of Texas and Oklahoma (see map, figure 274).
3. The agricultural belts of the central and north-central plains (see map, figure 277).
4. The great grazing plains (see map, figure 282).
5. The Rocky Mountains and the intermountain plateau (see map, figure 284).
6. The California-Arizona desert (see map, figure 285).
7. The Pacific-coast section (see map, figure 286).

In studying the sections of the United States, remember that it really is not possible to divide the country into "sections" so that each one will be sharply distinguished from the others that lie next to it. For example, if you will compare figures 272 and 277, you will note that the territory included in the agricultural belts overlaps considerably the territory included within the chief industrial section. This is because in some states which have important mineral resources and large manufacturing cities part of the soil is level enough and fertile enough to raise excellent crops.

There are other examples which show that it is a very difficult matter to decide upon a classification of geographic sections which will be satisfactory from all standpoints. We have chosen the sevenfold one, discussed in this chapter, because it is natural, easy to understand and to remember, and because it is one in which the overlappings between sections are not great enough to be confusing.

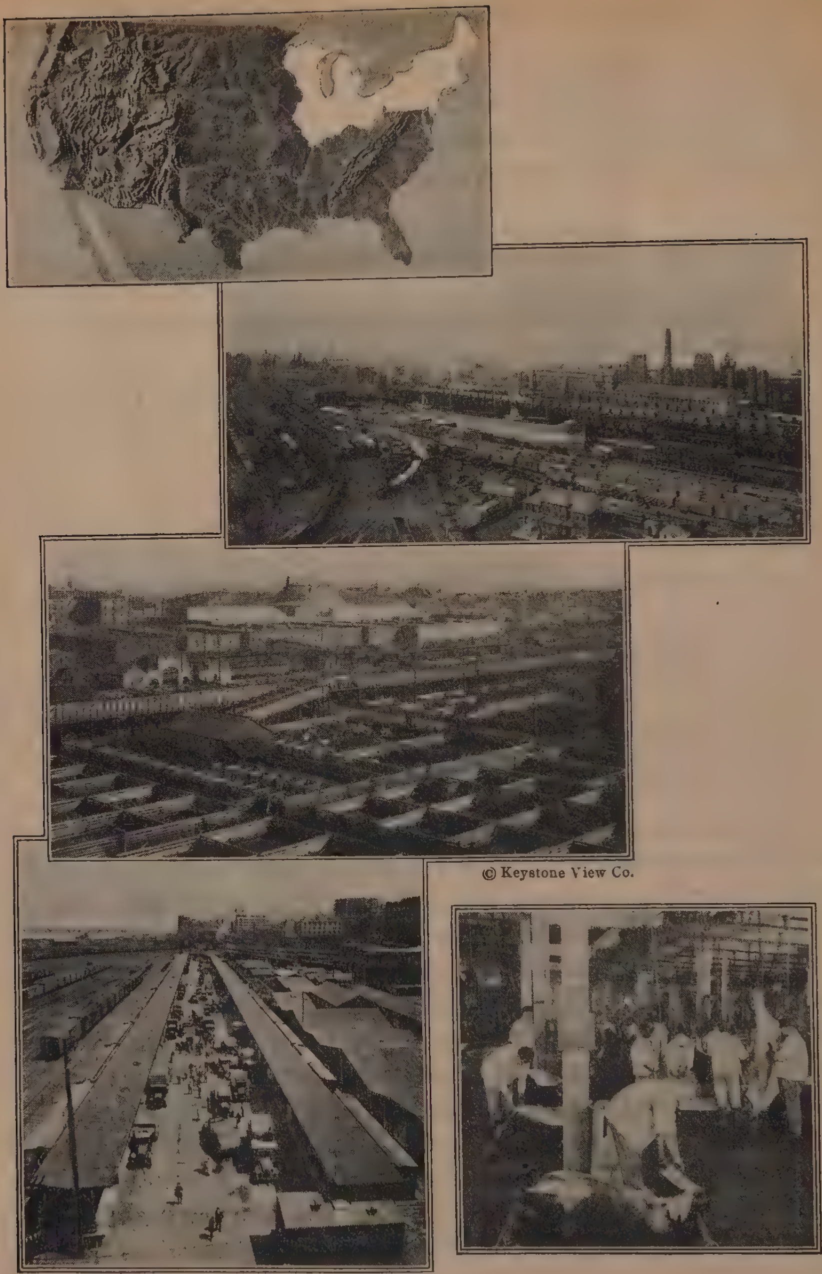

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FIG. 272. The chief industrial section is shown on these two pages.
and manufacturing plants. Here are broad fields of

Here are found many large cities and towns with industrial corn and wheat. Here also are fruit and dairy farms

As each section passes before your eyes, note how it illustrates the manner in which the geographic features — soil, lay of the land, mineral resources, temperature, and rainfall — determine where the people live and why they live there.

1. The Chief Industrial Section, including New England

In the preceding section we have learned that the United States is both an agricultural and a manufacturing country. We have also learned that the bulk of the manufacturing of the United States is done in the Northeastern states. This we shall call, for convenience, *the chief industrial section* (see map, figure 272). In several preceding chapters we have already learned several important facts about this section: *First*, that it includes New England and the states north of the Ohio River and east of the Mississippi; *second*, that within this section are practically half of the people of the United States, most of the largest cities, most of the immigrants, and a vast share of the wealth (see map, figure 180); *third*, that in the chief industrial section there are more miles of railroad, telegraph and telephone communication, and well-surfaced roads than in any other section.

How did it happen that these Northeastern states became such an important center of industry and population? The answer to this question can be found partly through a study of the geographic features — soil, climate, lay of the land, mineral deposits — and partly through a brief study of how people came to live there. Because New England was settled first and for a long time exerted an important influence on the life of the entire country, let us first review briefly the chief features of life in that part.

a. New England

When the first English people came to North America, they settled along the New England coast. In the early 1600's New England was a wilderness, and people could get a living only by hunting in the forest or fishing on the coast. With the establishment of the first settlements, however, men began to clear land for small

gardens and to build crude homes from the timber close at hand. Gradually they felled trees and uprooted stumps, and small farms began to make their appearance. The settlers found that grain would grow there only with difficulty. The land was too hilly, and the soil was rocky and sandy. On this soil, however, potatoes and other vegetables, hay, and fruit could be made to thrive. So the farms of New England were bound to be small because of the hilly and rocky character of the land. Today as one drives through the New England hills, he constantly sees stone walls dividing the little farms. These walls are made of rocks that once were strewn over the land.

For more than 150 years these English colonists tried to get a living out of the poor soil. After the Revolutionary War many of them gave up the attempt and moved westward into the Ohio and Mississippi valleys, where the land was level and fertile and grain-farming was profitable. As this was going on, after 1800, other New England farmers and their children found new ways of earning a better living. Factories were springing up along the short, swift New England rivers. Even before that time every village that could boast a brook had its mill wheel. Already the habit of spinning yarn and weaving cloth had been established among the New England people. Cotton was being grown by the Southern planters, and sheep were being raised on the Western plains, so New Englanders turned more and more to the manufacturing of cotton and woolen cloth, using the raw products of the South and West.

Other industries began to appear in the towns and cities of New England. The machine industry grew up. The manufacturing of shoes and textiles drew other farmers away from the unprofitable soil. Shops were opened for the making of fine tools, implements, and machines. The New Englander became known more and more as a skilled mechanic and as a merchant. Little by little many of the New England farms were deserted. In the later 1800's fields that had once been cleared of trees and underbrush became overgrown. The neat stone walls tumbled down, and the deer and the fox began to be seen again. Throughout many square miles of the northern New England states the land again became as wild as when the first settlers saw it.

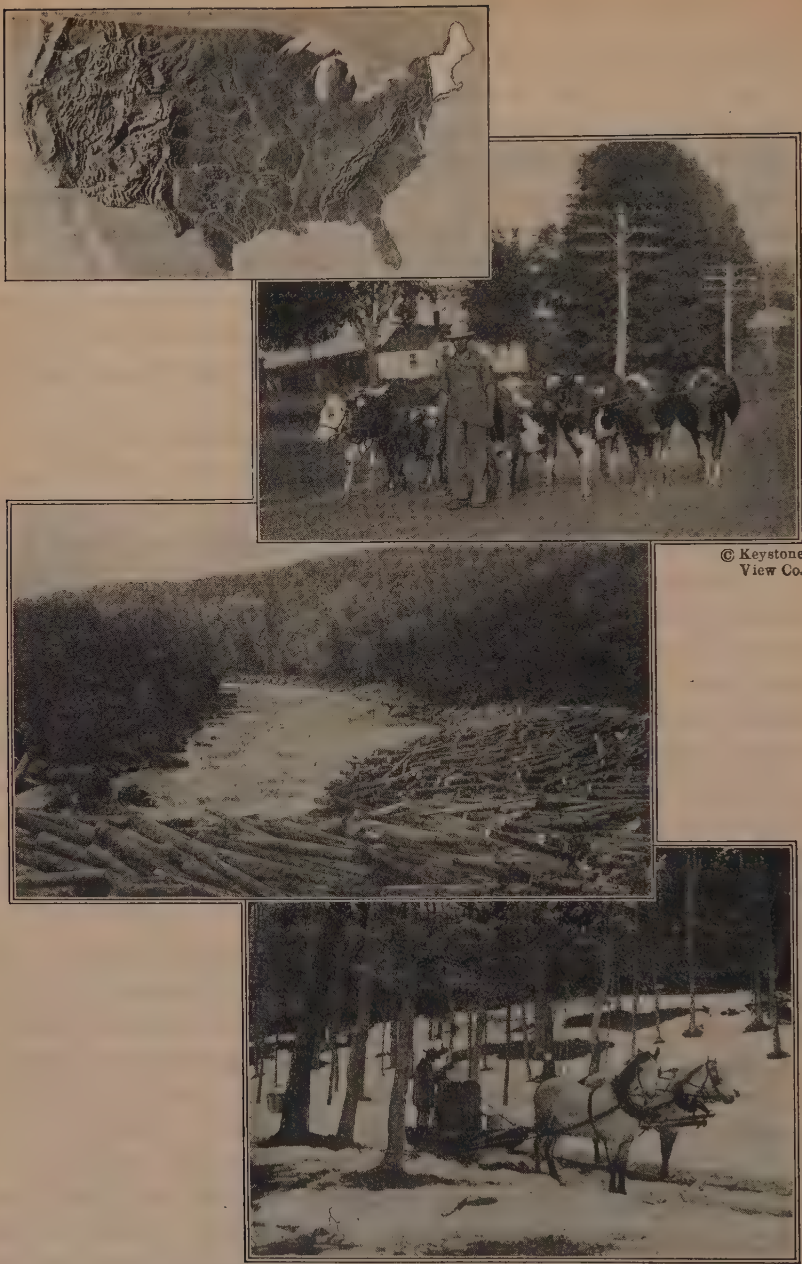

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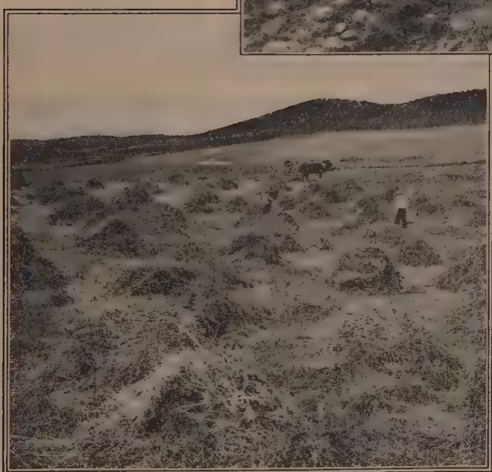
FIG. 273. New England lies within the chief industrial section.



These photographs, however, show its agriculture and lumbering

Those people who still farmed their land learned slowly how to raise certain crops that would grow upon the thin, gravelly soil. The pictures of figure 273 show the kinds of agriculture that have enabled these New England farmers to get a living. In Connecticut both soil and climate were found to be favorable for the raising of *tobacco*. Throughout most of the New England states, particularly Maine, farmers specialized in the raising of high-grade *potatoes*. Large crops of *hay* were produced, and the pasture lands stimulated the raising of herds of fine *cattle*. Thus the New England states became an excellent place for *dairying*. This kind of farming grew as good roads and railroads made it possible to ship milk, butter, cheese, and other dairy products to the markets of the growing towns and cities.

But even so, many people left the farms to go into the textile mills, the building trades, and the other mechanical industries. Forty years ago it was said of Connecticut, for example, "So great is the urban population, so meager is agriculture, that it is estimated Connecticut produces each year enough mutton to meet the needs of her people for only one day; and enough beef to meet their needs for only eight days." All the rest of the meat and practically all the wheat, corn, and other grains had to be shipped in from other sections, chiefly from the central agricultural belts and the cities of the western industrial section, which converted these raw products into bacon, flour, and other foods.

Summarizing: New England is an exceedingly small section of six little states (see figure 273). Its population approximates 7,000,000. About 80 per cent of its people live in towns and cities, in most of which some kind of manufacturing is carried on. It has one large ocean port and several small ones. Its agriculture consists of the raising of fruit, potatoes, truck vegetables, tobacco, and dairy products. Although the forests have been largely cut down, some lumbering still continues in the northern districts. New England, therefore, is a small, rather isolated section, dependent upon the rest of the country both for chief foods and for fuel to run its factories.

b. Great Lakes and central-coast states of the chief industrial section

The second section to develop was the district north of the Ohio River and east of the Mississippi (see figure 272). Excluding New England, these states are conveniently remembered as *the Great Lakes and central-coast section.* All of them touch one or more of the Great Lakes (as Michigan, Illinois, Wisconsin, etc.) or the seacoast (as New Jersey, Delaware). Pennsylvania and New York touch both the Great Lakes and the seacoast.

Throughout the preceding chapters we have referred many times to the way in which this section was populated with the building up of Ohio, Indiana, Illinois, and Michigan between 1800 and 1850. Recall the large immigration of Germans after 1850, and their settlement in Wisconsin, Illinois, and neighboring states. Likewise the coming of the Scandinavians and their settlement in Minnesota and the other north-central states. Since 1800 this region has developed, therefore, not only into a great farming section but also into the chief manufacturing section. How well the pictures of figure 272 show that fact! The top picture on page 451 portrays a typical Ohio farm, with moderately level land laid out with *varied crops.* If you will refer to figure 268, you will see that Illinois, Indiana, and western Ohio comprise nearly half of the great *corn belt* of the United States. We shall discuss the agriculture of these states later in the chapter. The other pictures of figure 272 remind us of the varied manufacturing industries of this industrial section. They show the *steel mills* in the Pennsylvania and Ohio district, and in the northern Indiana and Illinois district. They tell us of the great *railroad terminals* that have grown up in Pittsburgh, Cleveland, Buffalo, Detroit, and Chicago, and of the world's greatest *stockyards and meat-packing industries* in Chicago. They remind us of the *flour-manufacturing industry,* which caused Minneapolis to become one of our larger cities. They reflect the scores of *specialized kinds of machine manufacturing* and *mechanical trades* that grew up in these industrial cities.

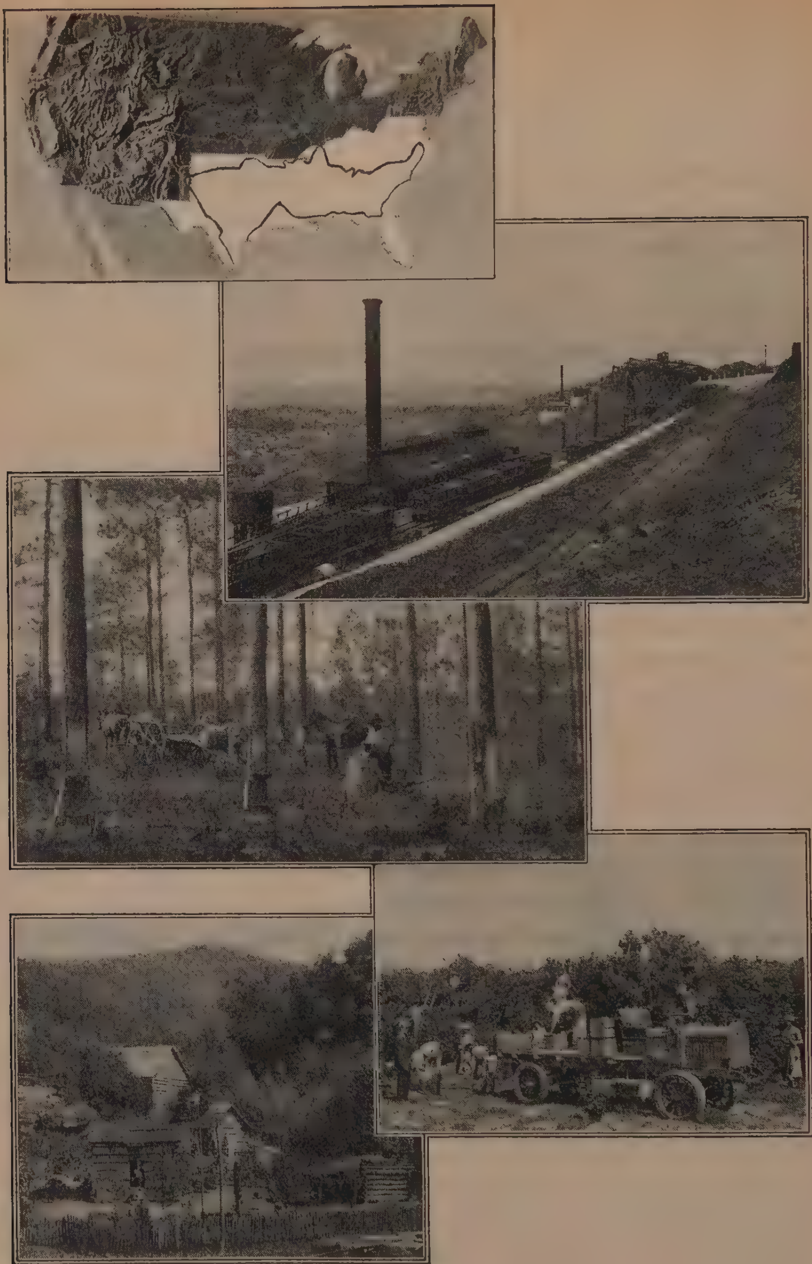
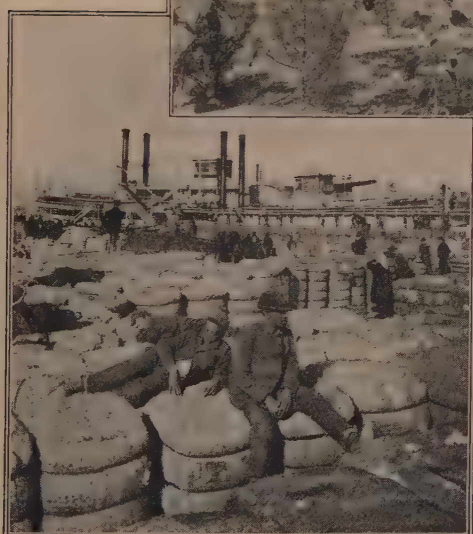


FIG. 274. The "New South" encircles the cotton belt. Once
year. Its inhabitants are engaged in cotton-growing, and





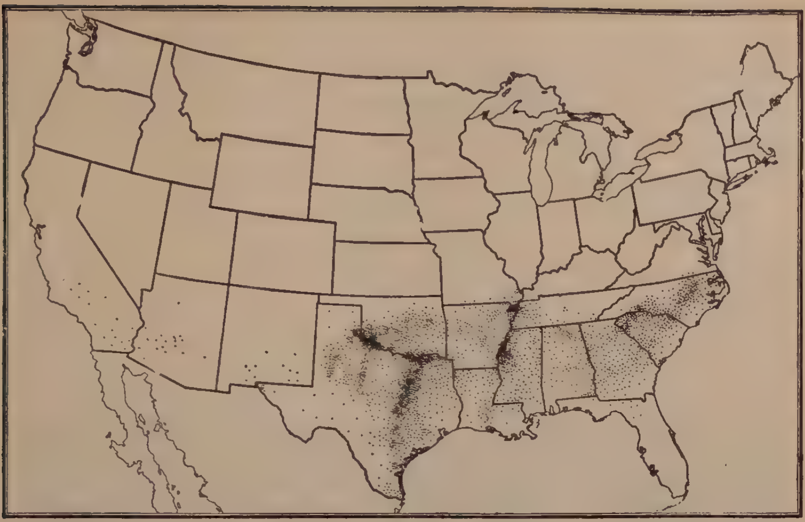
an agricultural region, it carries on more manufacturing each
in textile, iron, steel, and other kinds of manufacturing

2. The "New South"

The section which we shall call the New South is shown in white on the map of figure 274. Until nearly 1900 the people of these states depended for their living almost altogether upon the raising of cotton. The map of figure 274 marks out clearly this *cotton belt.* Note that within it most of the New South is included. This belt is indeed one of the most profitable cotton-raising regions in the entire world. There the early settlers found just the combination of soil and growing-season, temperature and rainfall, that they needed to produce this crop. There, as you learned in the last chapter, the growing-season is longest, in some places exceeding 240 days. More than 40 inches of rain falls there in a year, and the temperature rarely ever drops much below the freezing point.

Prior to 1800 the "South" consisted of the South Atlantic states — Virginia, Maryland, North and South Carolina, and Georgia. From the first settlement of these states in the 1600's and early 1700's, the English colonists lived chiefly on the profits obtained from the growing of tobacco and cotton. They knew little about how to farm scientifically, and by the time of Washington and Jefferson most of the land of these states was already worn out. The crops were small, and the plantations were unprofitable. After 1800 thousands of planters moved across and around the Appalachians into Mississippi, Alabama, Louisiana, and Texas. There they cut down the great forests and planted millions of acres of cotton. So rich was the soil and so favorable the climate that by 1850 the whole section had been settled and largely divided up into great cotton plantations. These plantations were so profitable that this section was known as the "Cotton Kingdom."

From 1861 to 1865 there was war between the Southern cotton states and the manufacturing states of the North. The war seriously set back the cotton-raising of the South. Slowly, however, from 1865 to 1890, the cotton planters recovered their industry. After that time a change came in the South. The old Cotton Kingdom was transformed into the new agricultural and manufacturing South. The Southerners discovered that in spite



Cotton production in the United States

Cotton mills in the United States

FIG. 275. These two maps together illustrate how the Southern states have changed from a one-crop (cotton) farming region to a combined agricultural and manufacturing region

of the climate people could work in factories. More and more, after 1900, cotton mills were built in North and South Carolina, in Georgia, and some in Mississippi and Alabama. Thus, instead of shipping cotton all the way to New England, as had been done for nearly 100 years, mills for the making of cotton cloth were built in the Southern states close to the cotton fields.

So rapidly did spinning and weaving mills develop that by 1920 South Carolina was the second largest cotton-spinning state in the Union, and North Carolina was third. Although Massachusetts

Fig. 276. Picking cotton on a plantation near Williston, South Carolina. (Courtesy of the American Agricultural Chemical Co.)

still continues to lead in the production of yarn and cloth, each year sees cotton mills closing their doors in New England. Certain New England manufacturing cities (for example, Fitchburg, Massachusetts) have recently declined in population because of the shifting of cotton manufacturing to the cotton-growing states.

In the meantime other industries are springing up in the South. In Tennessee and Alabama rich deposits of coal and iron have been found. In those localities large iron and steel industries are developing. Towns and cities are growing rapidly throughout this Southern section. Machine industries are springing up. The building trades are attracting workers. Better roads are being built; railroads are being improved. Parts of this section are

coming to resemble more and more the section north of the Ohio River. The larger part of the South, however, still continues to plant cotton. Soil and climate, taken together, determine that agriculture shall engage the labor of most of the people.

3. The Agricultural Belts of the Central and North-Central Plains

In the two preceding sections we saw (1) how the geographic features determine the way people live in New England and in the remainder of the chief industrial section; (2) how they determine the cotton and fruit agriculture of the South and steel, iron, and textile manufacturing.

Now we are to see this same principle illustrated again in the agricultural belts of the central and north-central plains (see map, figure 277). This section stands out very clearly on the maps of figure 277 and figure 268. The white area on figure 277 marks one of the richest corn-and-wheat belts in the world. This great agricultural plain extends from North and South Dakota on the extreme north, with their spring wheat, to the winter-wheat belt of Kansas, Oklahoma, Arkansas, Missouri, Kentucky, and northern Virginia on the south. A great central corn belt, nearly 1000 miles long and 200 miles wide, lies between these wheat belts.

We see, furthermore, that these rich farm belts overlap on two other sections to which we have referred; namely, the chief industrial section on the north, and the Cotton Kingdom on the south. Why? Again, because of the geographic conditions. In these central regions soil, temperature, and rainfall are favorable to the growing of the great staple foods, wheat and corn. Remember, therefore, that the agricultural belts include a considerable amount of territory that we also think of as falling either within the Northern industrial section or within the Southern section. This fact, if remembered, will also help us to understand that in any one of these chief sections many kinds of farming, manufacturing, and trade are carried on side by side.

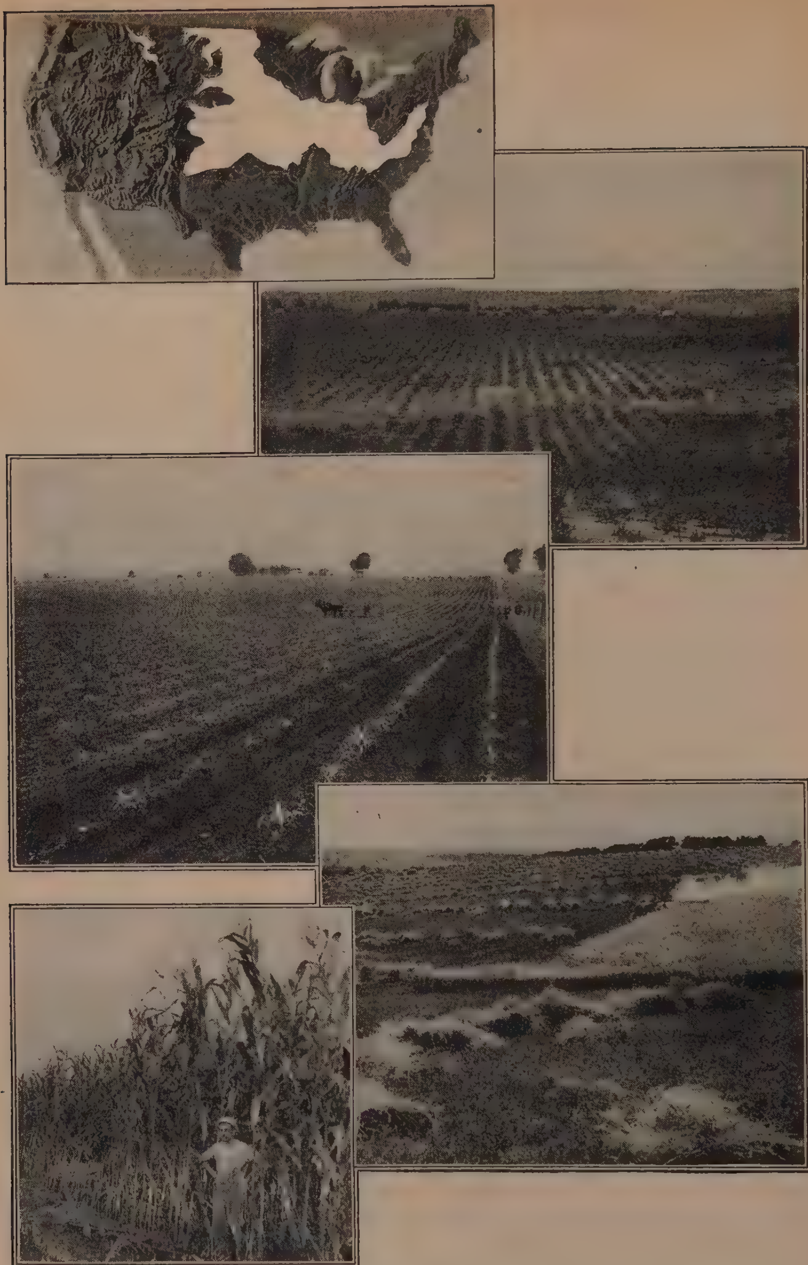


FIG. 277. In the agricultural belt of the central and north-central
live stock. Here, too, are found great flour mills,

plains most of the corn and wheat is grown, as well as much of the grain elevators, and meat-packing establishments

The first great farm product: corn

Corn is a comparatively new farm product. It was not grown in Europe until the early explorers in North America (in the 1500's) found the Indians growing it. Soon after, European countries imported it and began to raise it. Gradually the white colonists in North America began to grow it, too. Soon they learned how to produce it even better than the Indians. Throughout the Eastern colonies small amounts of corn were raised, merely enough for corn bread and other family uses on the farm or in the neighboring towns. As the settlers began to move into the Ohio and Mississippi valleys, in the early 1800's, they found that the level plains, with their large amount of rainfall and long growing-seasons, were favorable for the cultivation of corn. Between 1800 and 1860, therefore, in eastern Ohio, Indiana, Illinois, and Iowa, farmers made the raising of corn one of their chief occupations. You have already learned how, after 1860, agricultural implements and machines were invented, not only for the producing of wheat, but also for the raising of corn and other farm products. Furthermore, as scientists studied better ways of preparing and fertilizing the soil, and learned to plant different crops in successive years to enrich the soil, the farmers of the corn belt secured larger and larger yields from their fields.

Today the United States produces 70 per cent of the world's corn, nearly all of it raised in the states referred to as the corn belt. In the great corn-producing states of Indiana, Illinois, Iowa, Missouri, Nebraska, Kansas, and Oklahoma, and the eastern part of Ohio, from 80,000,000 to 90,000,000 acres of corn are planted each year.

No better example of the dependence of a crop upon climate could be found than corn, and no better illustration of the way in which rainfall and temperature together determine how people in an agricultural section earn their livelihood. Corn, for example, can get along with a small supply of moisture during the early and later periods of its growth. But in the middle season, when the ears are swelling, plenty of water is necessary. In our corn belt this comes from the end of June to early August. During this time the summer rainfall generally averages about ten inches. A slight change in the summer rainfall reduces or increases markedly

the value of the corn crop. For example, if the July rainfall in the corn belt averages two and a half inches in one year and three and a half in another, the difference in yield of corn will be from six to seven bushels per acre. Over the entire corn belt this would mean a difference in crop produced of 500,000,000 bushels. If the price of corn on the farm is a dollar a bushel, the value of this one added inch of rain is more than $500,000,000.

There is another important reason for the location of the corn belt, namely, the long summer season of uniformly high temperature. You have learned that corn grows well where the growing-season is in the neighborhood of 145 days. Fig. 267 shows that that is true of the corn belt.

So it is the combination of the right kind of soil, the right amount of rainfall, and the proper amount of warm, sunshiny weather that has developed our great corn belt.

The second great product of the agricultural belt: meat

The most important meat-producing region is in the corn belt. Why should corn be our greatest single agricultural crop, and why should we produce nearly three fourths of the world's supply of it? Not because we eat great quantities of corn, for we do not. Why, then? Because of meat! We Americans eat great quantities of meat and export large amounts to other countries. But, you are asking, how does that cause us to raise large amounts of corn? For the simple reason that the animals that supply our meat and do our work live largely upon corn. *As much as*

FIG. 278

85 per cent of our corn is fed to cattle, hogs, chickens, horses, and mules. Only 10 per cent of our giant corn crop is eaten by our people. Figure 278 sums up the uses of corn.

Americans eat more meat than the people of any other country. According to the statistics in figure 279, the average American eats six times as much meat as the Italian, twice as much as the Frenchman, one and a half times as much as the Englishman.

	Pounds
United States	156
England	105
France	74
Italy	23

Fig. 279. Annual consumption of meat per person

If the comparison were made for the Chinese, the Malays, the people of India and those of the Near East, it would be found that the average American eats ten, twenty, even fifty times as much meat as a person in those regions.

Where is the greatest amount of live stock raised from which this meat is produced? The map of figure 280 enables us to answer the question in regard to cattle: cattle are raised to some extent in every state of the United States, but more largely in the corn belt than in any other section. Note that the very center of the cattle industry (see the blackened part of figure 280) is in the state of Iowa, and remember that Iowa is also the leading corn-producing state.

But it is not only cattle that our farmers raise; they also produce horses and mules, sheep, swine, and poultry in tremendous numbers. The Department of Agriculture reported that in January, 1926, the number of live stock on farms in the United States was as follows:

Horses and mules	21,000,000	Sheep	40,000,000
Dairy cows	22,000,000	Swine	52,000,000
Beef cattle and calves	37,000,000	Poultry	464,000,000

Aside from poultry, our farms were raising 172,000,000 head of live stock. If we are properly to understand the agriculture of our country, therefore, we must remember that *seven tenths of all the*

farm land of the United States now under cultivation is used to raise live stock. Only two tenths of our farm land grows the vegetable and cereal food which is eaten by people, leaving one tenth to produce cotton, flax, and tobacco.

But even more astonishing facts have been discovered by the Department of Agriculture concerning the producing of meat. Their estimate shows that meat is a most expensive food. For example, to produce one pound of beef seven pounds of corn is fed to the cattle, in addition to other kinds of food. To produce

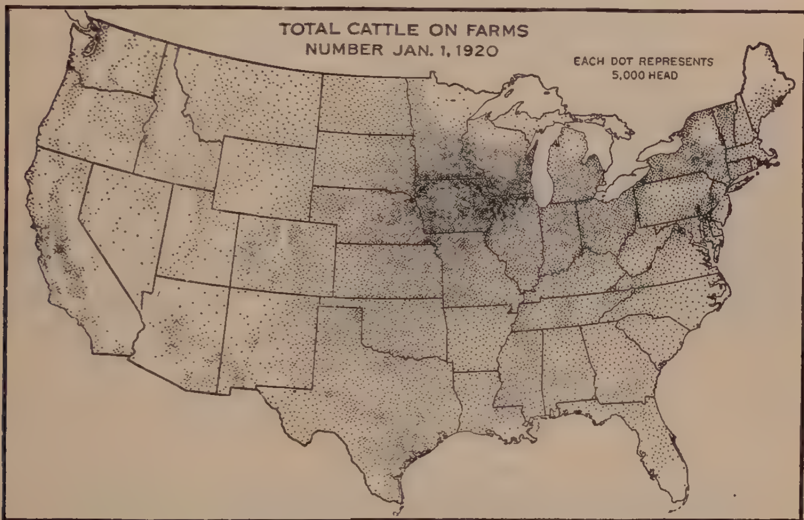


FIG. 280. Cattle map of the United States

one pound of pork five pounds of corn is fed to the hogs. Meat is indeed an expensive food. Now we are able to understand another thing about the standard of living in the United States, as compared with that in other countries. Figure 279 showed us that in our country we eat several times as much meat as the people of other countries, even those of the leading European countries. Now perhaps you can understand why crowded countries like China, India, and Italy, which have little room to grow anything but what is needed directly to feed the population, cannot afford to eat much meat.

Before leaving the question of the meat-producing sections we must refer briefly to the slaughtering of animals and the prepara-

tion of meat. Before the days of rapid transportation meat was eaten near the place where the animals were raised. There was little exporting of meat from one region to another, and almost none from one country to another. In sections of sparse population animals were often raised merely for their hides and for tallow, and the meat was wasted.

Then, after 1825, came railroads and steamships, and, after 1875, the invention of refrigerator cars and refrigerator ships. These developments of the Industrial Revolution made it possible

FIG. 281. This is one of the great meat-packing plants in Chicago. In a few central establishments like this much of the meat used by our people is prepared. (Courtesy of Armour Packing Company)

to raise animals in one region and ship prepared meats to be eaten by people in distant parts of the world. Furthermore, before the days of refrigeration many animals were shipped alive from the Western farms to the Eastern cities, where the slaughterhouses were to be found; but this was very expensive. Because the portion of the beef that may be eaten makes up only about half the weight of the live animals, there is a big saving in shipping the meat rather than the whole animal. Today, with refrigerator cars, it is much better to kill the animals and dress the meat in large packing establishments in our central cities and ship it over the country to the villages, towns, and cities where it will be eaten. So today most of the nation's slaughtering and meat-packing is carried on in Chicago, Kansas City, Omaha, and a few other large cities (see pictures in figure 272).

But to return to the discussion of the corn belt. We must not

think of it as a great area in which all the farmers are producing corn. The land in these states, in addition to yielding 5000 bushels of corn per square mile, is producing 2000 bushels of oats, 1000 bushels of wheat, and 150 tons of hay. Furthermore, in these central agricultural states — Ohio, Indiana, Illinois, Iowa, and parts of Nebraska and Missouri — are hundreds of small towns and cities. In most of these there are manufacturing and trade. The larger ones include a great diversity of manufacturing industries and the headquarters of the largest trading companies. So, in studying the chief sections of the country, we must remember that although each one reveals one or a few special industries, nevertheless, in each section can also be found examples of many other ways of earning a living.

The third great farm product: wheat

There is another important illustration of the manner in which geographic features, especially soil and climate, have determined the sections of the country; namely, the wheat belt. Wheat is our fourth most important agricultural crop (corn, hay, and cotton being first, second, and third, respectively, in money value). One third of all American farmers grow wheat. From 50,000,000 to 60,000,000 acres are planted in wheat every year. Furthermore, we export one sixth of our wheat crop to European and other countries, and without these exports our farmers would have little surplus income.

But there is another reason for the great importance of wheat. We depend upon it for our daily bread, for most of the bread we eat is made from wheat flour. The city people of the chief industrial section, the cotton-growers of the South, the cattle-raisers, miners, and fruit-growers of the Western states, all depend upon bread made from wheat flour, most of which is raised in the two great wheat belts of the United States. On the map of figure 268 these two belts stand out clearly: the spring-wheat section in North Dakota and part of South Dakota, and the hard-winter-wheat section in the south-central states, from Kansas eastward.

Why should there be two wheat regions, and why should they be so distant from each other? Simply because our farmers have

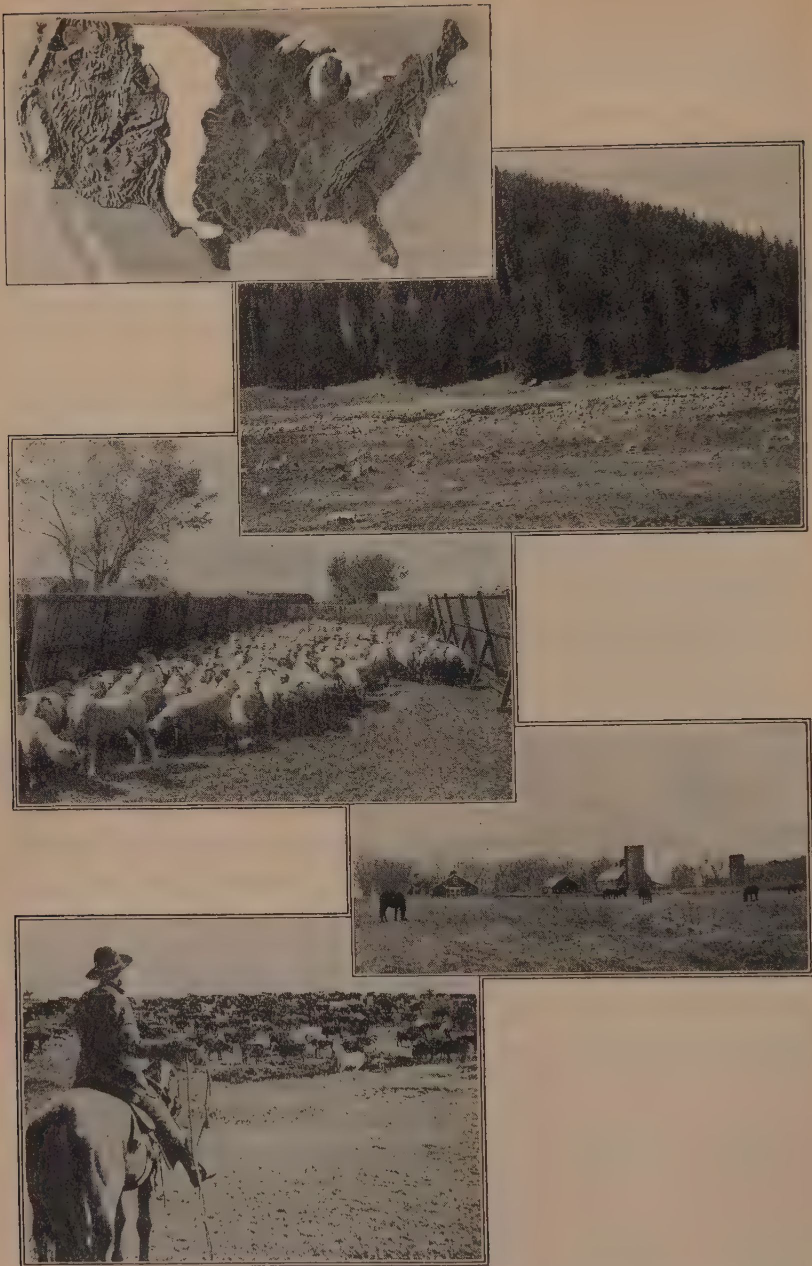


FIG. 282. The Great Plains make excellent grazing land for live stock. Here

lie some of our mines and forests. Few people are needed for these industries

developed two kinds of wheat seed, a winter-wheat seed and a spring-wheat seed. The winter-wheat seed needs a long growing-season. It is planted in the southern wheat belt in the autumn and comes up before winter sets in. During the mild winter season it grows very little. Light snows come and protect the plant from the cold. In the warmth of spring it begins to grow again, and in the early summer the crop ripens and is harvested. Winter wheat, therefore, is a crop that ripens slowly. It needs a long growing-season, with much moisture and heat. These conditions have been found in Kansas, Missouri, Kentucky, and the other regions marked out on figure 268.

The spring-wheat seed, on the other hand, grows very quickly. It can be planted in the spring and grows so rapidly that it is ready to harvest by the late summer. Hence the cold regions of Minnesota and North and South Dakota, combined with their favorable soil, have proved to be ideal for the raising of spring wheat. The same is true of the region just to the north in Canada. Hundreds of thousands of square miles of Canadian plains are planted each year in wheat. This whole agricultural section from western Minnesota through the Dakotas to Montana, and including the Canadian fields, is now one of the greatest wheat-exporting regions of the world. You have already learned of the important grain traffic on the Great Lakes. Millions of bushels of wheat are sent each year to Duluth and the Canadian lake ports for shipment by steamer to the Atlantic coast. From there they are sent to Great Britain, Italy, France, Belgium, Holland, Germany, and other countries. Of course much of this spring wheat is made into flour in the mills of Minnesota and shipped to the cities of our own country.

4. The Great Grazing Plains

In our study of where the American people live we have reached the western sections, those of most scanty population. Figure 289 reminds us, indeed, that the entire western half of our country is much less densely settled than is the eastern half. This is particularly true of the great grazing plains and of the mountain regions just to the west of them.

The map of figure 282 shows the section which we call *the great grazing plains*, a long strip of territory several hundred miles wide extending from the Canadian boundary on the north to the Rio Grande on the south. Throughout much of this region less than two persons are living per square mile (see figure 289). Why? Because the land and the climate will support little profitable farming, and because throughout most of the section there are few mineral resources. The rainfall throughout the section is less

FIG. 283. A cattle ranch in Colorado. (Courtesy of the American Agricultural Chemical Co.)

than in any other section of the United States (recall our discussion in Chapter III and see rainfall map, figure 270). Much of the land lies on a great plateau from 3000 to 5000 feet above sea level. Although there is much low-grade coal, there is little that is now worth mining. Naturally, therefore, people do not live there in large numbers. The few who do live there depend chiefly on the raising of live stock and of beet sugar and other crops that can be produced on irrigated land. We have already learned that large amounts of irrigated land are found in this section. The pictures of figure 282 and figure 271 show two examples of the profitable results already attained in this section by irrigation. This method of farming has come into use here during the last twenty-five years.

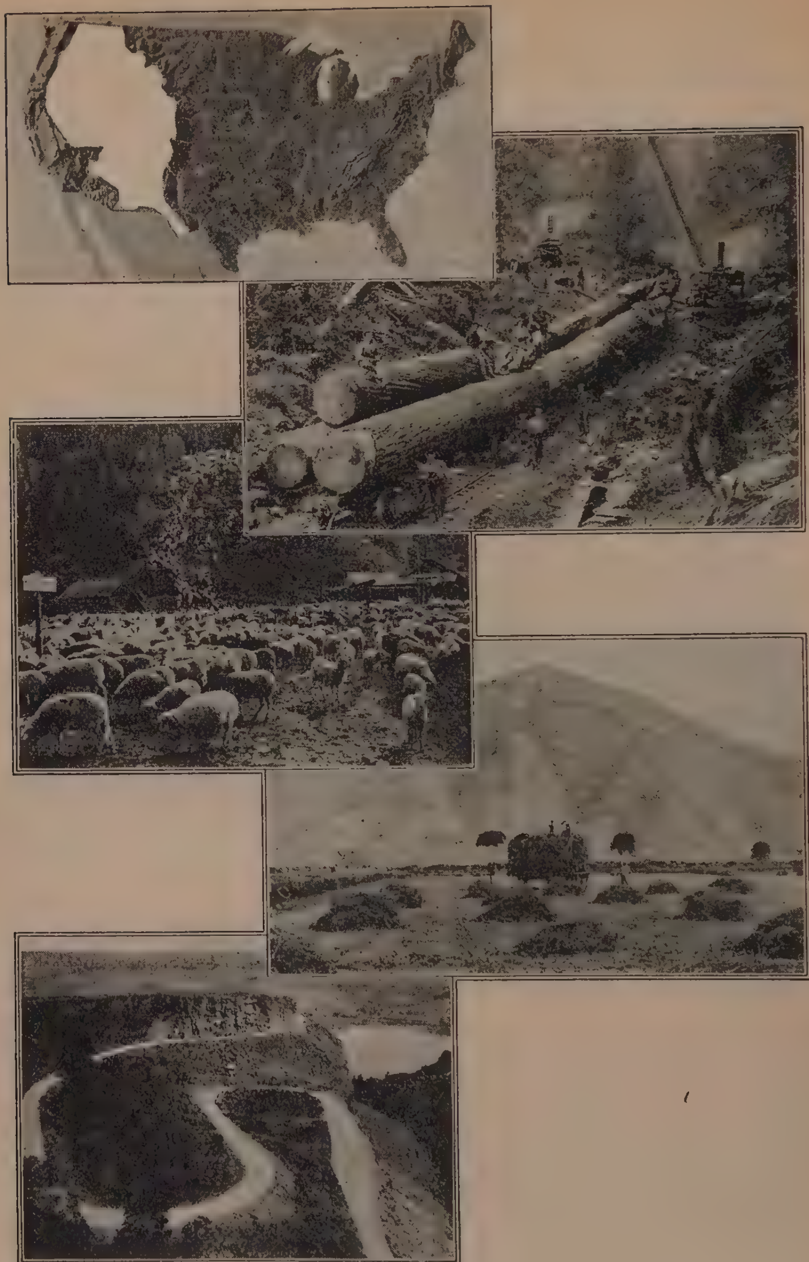


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FIG. 284. The Rocky Mountain and intermountain plateau section. Here are many

mines and power stations. Lumbering, grazing, and farming are also carried on

5. The Rocky-Mountain Section and the Intermountain Plateau

Bounding the grazing plains on the west and covering hundreds of miles in length is the tall range of the Rocky Mountains. These are the highest mountains in the United States, reaching altitudes of 12,000 to 14,000 feet. This range and the rough plateau to the west of it stood as a great barrier between the Pacific coast and the settlers of the Middle West. No doubt you recall the description in James Abbey's diary of the difficulties his party of Forty-niners encountered in crossing the Rockies when they were on their way to the California gold fields. In those days there were no speeding railways to take one comfortably around the great peaks through the beautiful but terrifying valleys. In spite of its forbidding appearance people have learned to live in this region. Not many, it is true, but in some sections as many as 25 inhabitants to the square mile.

In some parts of the Rockies, indeed, many more people are living than in the fairly level grazing lands of the plateau to the eastward. Why? Because of important mineral deposits — copper, zinc, lead, and the so-called precious metals, gold and silver. This section is one of the great mining regions of the world. For example, consider the mining of copper, in which the United States leads the world. In 1927 we produced 52 per cent of all the copper mined in the entire earth, and most of it came from Idaho, Utah, Arizona, and Montana. Mines of other valuable ores are scattered throughout this region.

Most of the mining centers are high up in the mountains, and a great many of them are reached today by railroads, which were constructed at great risk and with enormous expenditure by skillful engineers. Some mining towns, however, must still depend upon pack horses to receive their supplies and to carry out their ore. Indeed, a few of the towns in Colorado which depend entirely upon mining are almost inaccessible. Cripple Creek and Leadville, two miles above sea level, are isolated from other communities.

Although in the mountains mining is practically the only occupation, in the fertile protected valleys between them profitable agriculture is carried on. In the northern part of the region these

valleys have been planted with apple orchards. Our Western farmers have learned to raise delicious apples on the soil and in the climate of the high plateau states. Apples were the first fruit exported from the United States, and for a long time were grown only on the Atlantic coast; but now this Northwest section rivals the East in the production of apples.

In the less fertile valleys and along the forested mountain slopes great herds of sheep graze. In New Mexico, Utah, and eastern Oregon herds of 2000 to 3000 sheep are taken in the summer time to graze in wide, open basins high above the timber line. There the animals crop the grass, eating it so closely that there is nothing left for other beasts when they have finished. When the cool weather comes, the shepherds and their flocks move down again into the foothills and lower lands for winter pastures. Most of this land belongs to the national government, and sheep-owners pay small fees for the use of it.

Still other industries have persisted in this region and make livelihoods for a few people. Consider, for example, the lumbering business. Many of the mountain slopes and valleys are heavily forested. The Sierra Nevada and the Coast Ranges are among the first forest districts in the world. There grow the tall, straight Douglas firs, sometimes 10 feet in diameter and 100 feet or more in height. What masts they make for sailing ships! Still farther north, in eastern Oregon, pine is raised and shipped in great quantities. The United States is, indeed, the largest lumber-producing country in the world, and at the present time the Rocky Mountain and Pacific-coast states produce more than a third of the annual supply of the entire world. Most of this timbered land is owned by the United States government. It is protected by trained forest rangers, who keep constant guard against fire, oversee the sheep-herders, and have charge of the lumbering in the forests.

As to the future of this region, there is one possibility for valuable development; namely, the use of hydroelectric power. Already the swift-flowing streams of the northern mountains have been dammed, and large water-power plants have been erected by the great transcontinental railroad lines. There are several hundred miles of railroad track over which trains are hauled by

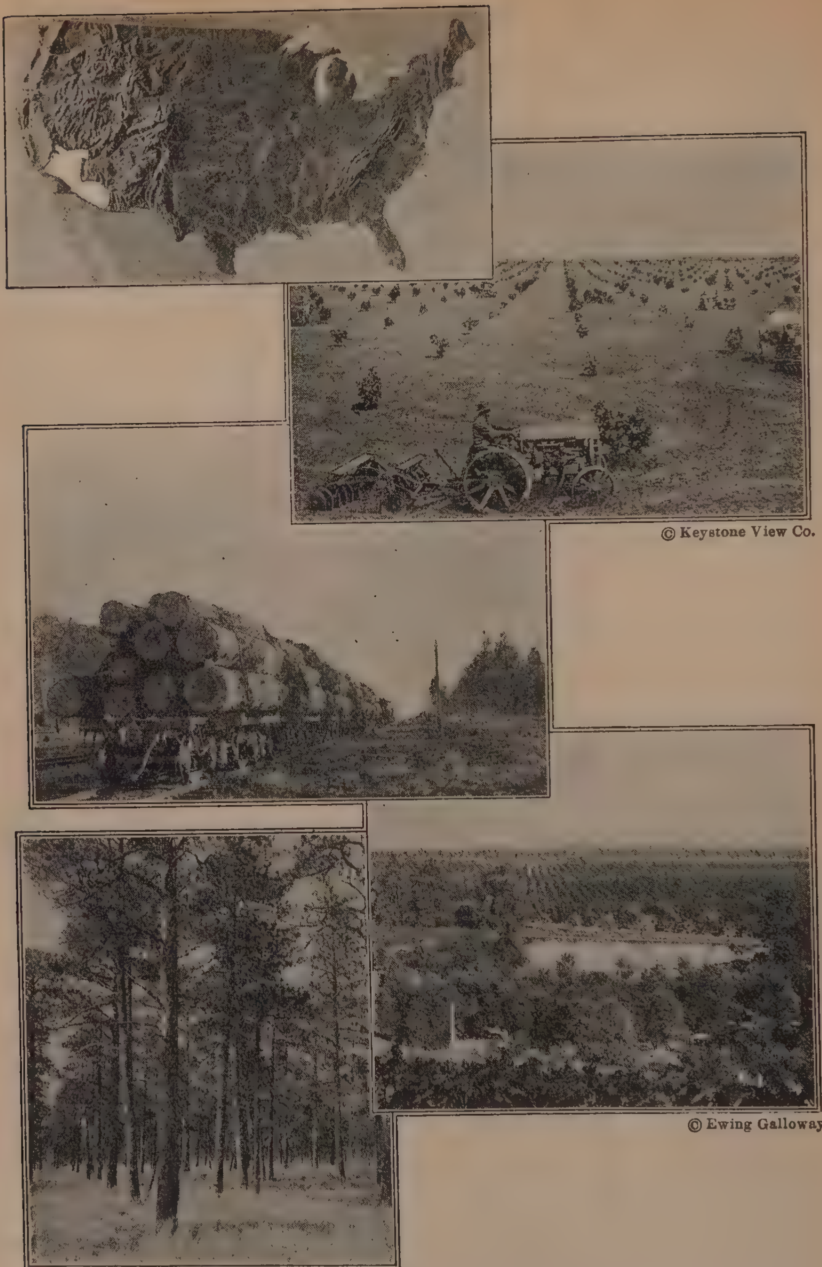

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FIG. 285. The California-Arizona desert section. Here irrigation, spots like that shown in the picture

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Photograph from Keystone View Co.

lie great irrigated fruit-growing and mining lands. With
at the top of this page might produce crops, too

electric engines. Mining towns in the vicinity are using hydro-electric power to operate their mining tools and mill machinery, to light buildings, and to transport goods.

6. The California–Arizona Desert

The map of figure 285 shows one small district in the great intermountain plateau section that is worth considering by itself; namely, the California-Arizona desert. In this dry, semidesert country rain rarely falls. There is less than ten inches of rainfall a year on the average. Nevertheless people have gone there to live, and today vast districts of the region have been cultivated by means of irrigation. Irrigation on a small scale was practiced here more than 300 years ago by the American Indians. By carrying water to their fields they managed to raise small crops. Then in the 1600's and 1700's the Spanish priests and missionaries came up from Mexico, bringing with them new fruits — the fig, the olive, and the lemon — which could be raised in that climate, provided the soil could be watered. A score of missions were started, and around them grew up little centers of agriculture and handicraft. For 200 years their fruit farming has persisted, and today the names "mission fig," "mission olive," "mission grape" remind us of our debt to the early cultivators of the desert.

Then in the 1870's citrus-fruit industry was extended with the raising of oranges and grapefruit. Farmers in southern California and in parts of Arizona found that they could grow delicate citrus fruits other than lemons, provided they guarded their orchards against low temperatures (see pictures, figure 285).

But the great secret of the development of this section was irrigation. Water proved indeed to be the means of reclaiming the desert. Where there is no life-giving water, the desert is a dry waste of fine brown soil, covered with tall cactus and sagebrush plants. On this the sun beats down unceasingly. No passing rain-cloud interrupts its steady blinding heat. As one travels through the desert, objects ten or fifteen miles away are easily distinguished because of the clearness of the air. The mountain ranges seem like painted mountains, for their bare slopes, seen through the dancing light, are tinted pink, blue, and lavender.

But much of the soil itself contains excellent plant foods, and needs only water to produce fine crops. So in this section the national government has built great dams at certain places. There is, for example, the Roosevelt Dam in Arizona, which stores up the water of the Salt River and distributes it as it is needed throughout a vast territory. The lands that are within the reach of this irrigation system have become very valuable, selling for $1000 and more an acre.

But the soil of this section is rich in mineral products as well. For example, in the California desert, the soil of Death Valley contains borax which has proved to be of considerable commercial value. In this region, even as far north as Nevada, nitrate of soda — an excellent fertilizer — is also found.

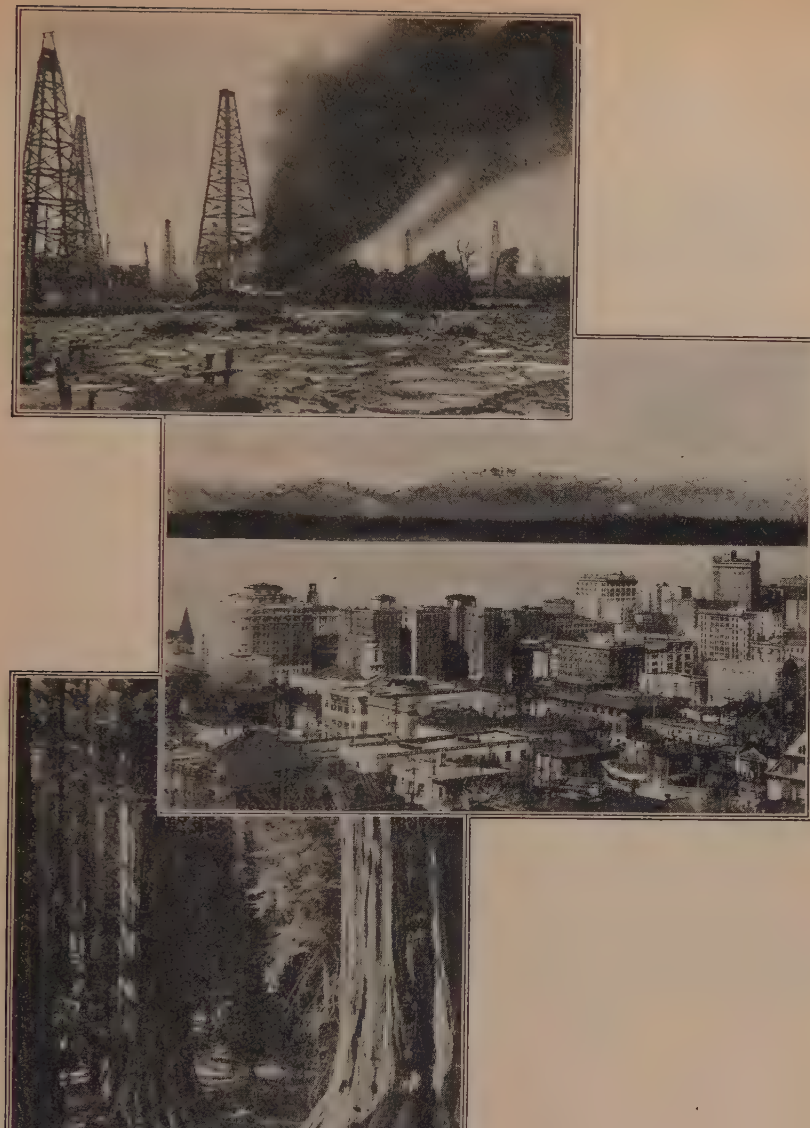
And then there are the rich mines. The copper mines of Arizona are among the greatest in the world. And the gold and silver mines are nearly as important. In a recent year $155,000,000 worth of these three minerals was taken out of the earth.

7. The Pacific-Coast Section

Finally, in our westward survey of the chief regions of our country, we reach the long, narrow Pacific-coast section. Again we find new examples of the manner in which geographic factors determine where and how people live. Here is another section with a peculiar combination of rainfall, temperature, lay of the land, and natural resources. The warm winds from the Pacific play over the northern section of this coastal region, depositing upon much of it annually 60 inches of rainfall. If you will refer to the rainfall map, figure 270, you will see that this coastal section is divided into two rather distinct regions. The northern half, which includes Washington, Oregon, and northern California, receives a very large amount of rain. The southern half, including southern California, has very little rainfall. All the coastal section is an important fruit-growing region. Apples, peaches, and pears are found in the northern half, and semitropical fruits are found in the southern half.

Because of the dryness of the southern half of the section it is excellently adapted for the drying of fruit. Hence, in California

Fig. 286. The Pacific-coast section. Here one finds oil, water power, and factories. The population is



not only fruit in abundance but also great forests, much greater here than in the neighboring sections

especially, we find a great industry has developed for the preparing of prunes, apricots, raisins, pears, peaches, and other fruits. California, indeed, produces more raisins than do all the other regions of the world. As the traveler moves through southern California during the rainless, sunny summer months, he sees in many districts large trays of raisins and other fruits spread out to dry.

FIG. 287. A redwood forest in California. Compare the height of the trees with that of the man standing beside one of them. (Courtesy of the United States Forest Service)

Because of the fruit, the canning industry has grown up throughout this section. California cans nearly all the apricots and a large proportion of the peaches used throughout the United States. Not only fruits but also asparagus and other vegetables are raised here in large quantities and canned for Eastern markets.

Doubtless the industry which you associate with the name California, however, is not agricultural at all, but mining. It was gold that drew men from the Eastern states to California in 1849 and the years immediately following. The hope for great riches to be scooped out of the gravels of California streams caused men to risk the torture of the journey across the plateaus and over the mountains of the West. Fortunes were made in that region, but after a few years all the loose surface gold was claimed. Then

underground mining developed. Shafts were sunk, as in the mining of coal, and miners dug for gold deep down under the surface of the earth.

In recent years there has been another discovery of mineral wealth in California. Oil — liquid gold! The country's greatest oil region is located near Los Angeles, in southern California. Near the cities of Los Angeles and Long Beach today oil derricks are as thick as those shown in figure 86, Chapter IX. From the harbor oil tankers carry their cargoes of fuel through the Panama Canal to the eastern coast of the United States or on to Europe.

FIG. 288. These men are setting out young trees in one of the national forests. (Courtesy of the United States Forest Service)

Two other industries round out the important work that people do in this Pacific-coast section — namely, fishing and lumbering. The west slopes of the mountains in the northern half are still well covered with timber. In California are the giant redwoods, which are among the largest and most valuable of trees (see figure 287).

In the north, especially in Washington, are the great fishing and fish-canning industries. In a recent year $86,000,000 worth of canned fish, two thirds of which was salmon, was produced in the United States and Alaska. The fisheries and allied industries of the northern Pacific-coast region and of Alaska employ nearly 200,000 people.

Summary: where the American People Live

This completes our brief survey of the chief sections of the United States. We have really been discussing one important problem; namely, where the American people live and how they live in their respective sections. We are now prepared to summarize the chief facts which we have discovered concerning it.

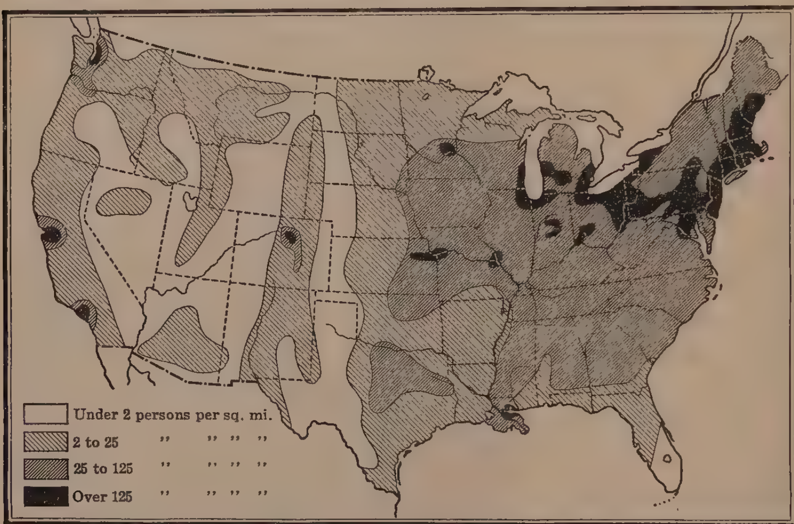


Fig. 289. The various shadings on this map show how thickly populated are the various sections of the United States. Note, first, that the blackened areas show where our largest cities and towns are, and that most of them are in the chief industrial section; second, that the population in the eastern half of the country, both north and south, is denser than in the western half; third, that the population is scanty in the mountain and plateau sections

First, consider the distribution of population (see figure 289). Imagine, for convenience, that all the people of the United States had divided the nation's land equally between them. Each person, including boys and girls as well as adults, would then own about eighteen acres of land. If, furthermore, each person decided to live on his own plot of land, approximately 35 people would live on each square mile of land in the United States. If a map were drawn to represent that situation, it would be dotted over the entire territory evenly, somewhat like the map of Iowa shown in figure 290.

But our imaginary picture of the distribution of population is far from a true one, as shown in figure 289. Instead of being scattered evenly over the continent, about half the people live in one of our seven sections; namely, in the industrial zone. In that section, and in a few centers outside it, people live huddled together in great cities. In some parts of New York the population totals more than 18,000 persons to each square mile of area. A like situation occurs in the densest parts of a number of other large cities. Contrasted with this extreme concentration of population, there are thousands of square miles in Arizona, Montana, and Nevada averaging less than two persons per square mile. In the roughest mountains and in the deserts there are many square miles where no human beings live at all.

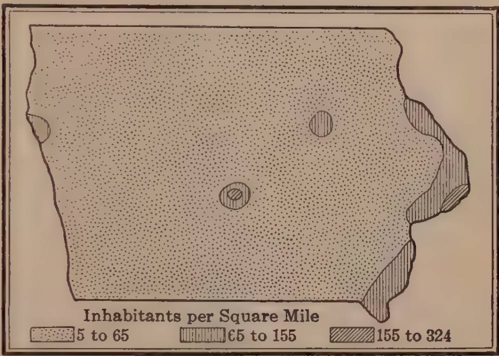


Fig. 290. This map shows the number of inhabitants per square mile throughout the state of Iowa. This is an excellent example of very even distribution of population over a fairly level plain. No county in the state has a density of less than 22 people, or of more than 200 people, to the square mile

Why do so many people live in the chief industrial section, a large number in the eastern half of the United States, and so few, on the average, throughout the western half?

With the facts of the foregoing pages available, we now know what it is that plays the greatest part in determining where our people live and how they live. We have learned that it is the lay of the land, whether mountainous or level; the temperature, whether hot, cold, uniformly moderate, or changeable; the rainfall, whether light or heavy. We have learned that the supply of minerals, the location of waterways, lakes, and rivers, and the fertility of the soil are all factors.

Men have settled in places where they can most easily make a living. It now appears as if it were nature rather than man that determines where cities and farms shall grow up. Nature pro-

vides men with broad valleys and plains along river bottoms where they may build farms. Nature supplies river valleys and open spaces where it is easy to build roads, canals, and railroads. Nature stores up iron and rich veins of coal in the earth. Nature provides rushing water and lakes of oil and great deposits of coal, from which man can produce power.

In this chapter we have brought together several maps which will help you to remember how and why the people of the United States live where they do.

Consider, first, the question of the lay of the land. The relief map of figure 265, when compared with the map showing distribution of population, figure 289, shows clearly that very few people live in most mountain regions. Note how few people live in the region of the Rockies, the Cascades, and the Sierra Nevada.

At first glance it appears that we could draw the conclusion, "In the mountains population will be small; in the plains it will be large." But a little study convinces us that there are important exceptions to this conclusion. Figure 289 reminds us that in the mountains and hills of Pennsylvania many people are living, even in cities of considerable size. Why? Because of the fortunate circumstance of the large deposits of coal, easily mined, and needed in various kinds of manufacturing. As the chief industrial section grew in population, therefore, one industry after another established itself in the general vicinity of the coal region. In spite of the mountains people went there to live.

Consider, second, the distribution of population on the plains. Are people *evenly* scattered across the great plains? Throughout the corn and wheat belts, yes. With the exception of small spots where manufacturing cities and towns have grown up, population is rather evenly distributed. Through the region from the Atlantic coast to Iowa and Missouri the average is from 25 to 125 persons to the square mile.

Figure 290 illustrates the fact that an important agricultural plain scatters population rather evenly. Throughout most of the area there are almost no large cities. Note that all but a few small spots in the state average from 5 to 65 inhabitants to the square mile. This is typical of vast areas throughout the corn, wheat, and cotton belts.

Even in the level plains there are exceptions, as shown by the occasional small areas of extremely dense population in the agricultural sections. Note, however, that these occur on waterways (for example, St. Louis, Kansas City, St. Paul), at the junction of transportation lines (Chicago, Indianapolis), or, in occasional instances, near mineral deposits.

Other things being equal, agricultural plains lead to fairly *even* scattering of population. Mountains lead to scantiness of popula-

FIG. 291. This map shows where the industrial cities of the United States are located. There are about 196,000 factories in our country

tion. In the light of our previous studies we can next summarize briefly other principles which help to determine where people live.

1. Population tends to be dense near rich deposits of coal (compare figures 70 and 289).

2. Population tends to be much more dense where rainfall is moderate or large in amount than where it is small in amount (compare figures 270 and 289).

3. Population becomes more dense in regions thickly covered by railroads, waterways, telephones, and telegraph lines (compare figures 166 and 289).

4. The densest population occurs where factories are built in largest numbers (compare figures 289 and 291).

INTERESTING READINGS FROM WHICH YOU CAN GET ADDITIONAL INFORMATION

Books

*Gabriel, Ralph Henry. Toilers of Land and Sea (Volume III of The Pageant of America). Yale University Press, New Haven, 1927.

Chapter VII (The Cotton Kingdom), Chapter VIII (Cattleman and Nester), Chapter IX (The Clanking of Machines), Chapter X (The Age of Science), and Chapter XI (The Farmer of the New Day).

*Huntington, Ellsworth, and Cushing, Sumner W. Modern Business Geography. World Book Company, Yonkers, New York, 1925.

Chapter I (Cotton: an Example in Commercial and Industrial Geography), Chapter XI (Lumbering and Forest Products), Chapter XVIII (The Geographical Conditions of Manufacture), and Chapter XIX (Manufacturing Regions of the United States).

Tappan, Eva March. Modern Triumphs (Volume XIV of The Children's Hour), Houghton Mifflin Company, Boston, 1916.

Pages 158–180 contain a thrilling account of the exploration required before a valley section in southwest Colorado was irrigated.

Magazine Articles

*"Birmingham — the Next Capital of the Steel Age," *World's Work*, March, 1927, pp. 534–545.

*"Missouri, Mother of the West," *National Geographic Magazine*, April, 1923, pp. 421–460.

A good description of the varied industries of Missouri.

*"Seeing America with Lindbergh," *National Geographic Magazine*, January, 1928, pp. 1–46.

A bird's-eye view of the great industries of a vast country.

"So Big Texas," *National Geographic Magazine*, June, 1928, pp. 638–693.

Work in the grazing region of the United States.

*"The Industrial Titan of America: Pennsylvania, Once the Keystone of the Original Thirteen, Now the Keystone of Forty-eight Sovereign States," *National Geographic Magazine*, May, 1919, pp. 367–406.

"Trailing History down the Big Muddy," *National Geographic Magazine*, July, 1928, pp. 73–120.

A good description of the industries bordering the Missouri River.

Note. The pictures appearing on pages 450–451, 454–455, 458–459, 464–465, 472–473, 476–477, 480–481, 484–485 come from several sources. Among them are those made from photographs furnished by the American Agricultural Chemical Co., the General Electric Co., the Great Northern Railway, the Minneapolis Civic and Commerce Association, the Southern Pacific Bureau of News, the Tennessee Coal, Iron, and Railroad Co., and the United States Steel Corporation. These are all used by permission.

UNIT VIII

HOW THE AMERICAN PEOPLE TRADE

HOW THE AMERICAN PEOPLE TRADE

Most of the chapters of this book have dealt with the Industrial Revolution. Paralleling the Industrial Revolution, however, there was also a commercial revolution, a change in trade or in the way in which things were bought and sold. Much of that change has come about in the last 100 years. We shall turn next to a brief study of trade. It will be necessary first to study the manner in which simple forms of trade developed and how men began to use money and credit. It will be necessary also to study examples of how trade is carried on now in a large country like the United States. We shall see how food and other things are brought from farm and factory to the home. Finally, we shall need to know the part played by banks in carrying on trade. It is doubtful whether the business of a large country like the United States could be successfully carried on without the aid of banks. It is important, therefore, for us to understand what a bank is, where the money comes from that the banker uses, how banks help us all, and how banks especially help trade. These topics will be discussed in Chapter XXV.

To produce coal, steel, and manufactured goods in large quantities, very large sums of money were necessary. Hence, no sooner did machines and engines come into widespread use than men looked about for ways to collect large enough amounts of capital to build great factories, to equip them with machines, and to employ larger numbers of workers. They discovered how to do this by forming larger and larger companies, which did great amounts of business by means of huge accumulations of capital. We must understand how these large business organizations were formed. That will be the subject of Chapter XXVI.

Finally, in Chapter XXVII we shall extend our view of trade to include the trade of our merchants with other parts of the world. Throughout the history of all known civilizations peoples have traded with each other. We shall study, therefore, the trading of our people in earlier years and the growth of foreign commerce in recent times. With the great increase of wealth in the United States, our people have invested much of their savings in business enterprises in other lands. In order to understand the trade of our own country, therefore, we must also study our foreign investments. These problems will be taken up in Chapter XXVII.

CHAPTER XXV

TRADE — BUYING AND SELLING

When you go down town you see streets filled with automobiles and trucks, and sidewalks filled with people. The people go in and out of doors all day long. They are engaged in buying things. In

FIG. 292. This is one of the largest department stores in the world. It sells more than 750,000 different kinds of articles. It has 1,500,000 square feet of floor space. Each day approximately 100,000 sales are made in this store. (Courtesy of R. H. Macy & Co.)

small towns or in large cities, as far as the eye can reach and beyond, there are stores which streams of people enter and leave, day after day, year in, year out. Customers come in to buy. Clerks and salespeople are there to wait upon them.

Walk along the street and notice the stores that you pass. On this corner is a cigar store. Next to it is a florist's shop. Then in succession the tailor's, the stationer's, the dry-cleaner's, the clothing stores, and the food stores. On the corner is a drug store.

Beyond this are restaurants, hardware shops, stores selling lamps and electrical fixtures, bird stores, laundries, and on the next corner a second drug store. Another block presents the same succession of stores, all doing business, all displaying their goods in windows to attract people to come in and buy.

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FIG. 293. This store, the first department store in the United States, was opened near Duxbury, Massachusetts, in 1660. This might be a picture of almost any small country store today. "General" stores they are called, because they sell everything in general

Wherever we look on city streets we see shops and signs inducing us to buy. As we walk along the streets we are frequently made to want things that ten minutes before we did not know existed. All kinds of skillful methods are used to induce us to buy, for today selling is the business of a large group of trained people.

Towns and cities could not exist without stores; wherever people settle in communities stores spring up.

A Vast System of Buying and Selling has grown up in the United States

To supply the 115,000,000 people of the United States with food, clothing, and the multitude of articles which enable them to live a comfortable life, many people are engaged in buying goods from those who make them and in selling them again to the people who need them.

We have learned in this book of the enormous production of foodstuffs on our farms, of coal and oil to run our engines, of iron and other raw materials to manufacture our goods. We have learned of our great army of workers and of our vast systems of transportation and communication. These would be useless without a corresponding system of trade — of buying and selling the food, raw materials, and manufactured goods.

A nation-wide, efficient system of trade has grown up hand in hand with the new systems of agriculture, manufacturing, mining, and transportation. From the earliest days of colonial history and throughout the Westward settling of the continent, most of the communities grew up around traders. Indeed, the history of the Westward movement of our people shows that the trader was the real pioneer. He was the trail-blazer. There were traders in the Ohio and Mississippi valleys many years before the first settlers built communities there. There were traders in the Far West, buying and selling to the Indians, long before people went in large numbers to make farms and establish villages and towns in that region. Hence it is important to remember that, although we study the business of trading last, actually trading grew up with the making of goods thousands of years ago. Wherever human beings come together, trading forms part of their life.

Now trading in a large country like the United States is carried on not only in the *retail* stores which you see on city streets but in many other ways. These retail stores are merely the last link in a complicated chain of trading, which brings food from the farms, and clothing and other goods from the factory, to your neighborhood where you can purchase them. Most of the local stores do not make the things which they sell us. They buy them from other people whom we call *wholesalers*. These wholesalers bought them from manufacturers. The manufacturers, in turn, bought the raw materials from other people.

The buying and selling of things in a vast country like the United States needs more than just *stores*. In our towns and cities, therefore, there are office buildings filled with people who are buying and selling things, most of which they never see. They are ordering, by telephone or telegraph or letter, great numbers of cattle to be shipped to the meat-packing plants of large cities, or vast quantities of meat to be sold in distant cities and towns of the nation. They are selling lumber, steel, cement, stone, and other materials to be used in building houses and many other structures. They are buying and selling yarn, cloth, and garments in wholesale lots. Hundreds of thousand of clerks, messengers, traveling salesmen, bookkeepers, accountants, and business managers make up this nation-wide system of trade.

In the cities and towns wherever we look, we see something connected with trade. Stores, tall office buildings, banks, railroads, river barges, vast ocean liners, all help trade. Towns and cities grow up because they are trading centers or because they supply something which is valuable to trade. Railroad terminals and seaports exist largely because of trade.

Millions of people earn their living in trade. Of the 41,000,000 workers in the United States, approximately one tenth are engaged in buying or selling.

What are the Main Steps by which Trade has developed?

1. Barter: the simplest form of exchange

Trade has always meant *exchange*, whether it is exchange of goods for goods or goods for money. Two people trade when each has something the other wants. For example, there are two boys, John and Bill, each of whom has something to exchange with the other. John has a jackknife; Bill has a scout ax. John wants a scout ax; Bill wants a knife. So the ax is exchanged for the knife. This is the simplest form of trade. We call it *barter*.

In just this way trade is carried on among primitive people. They exchange what they have in plenty for what they lack and what they want. The American Indians, for example, traded great tracts of land and valuable furs for beads and other trinkets. They had so much land and so much fur that these meant little to them. They did want beads and other trinkets, which were new and attractive; so they traded with the white men. It was the only way they knew to get what they wanted.

There may be some difficulty in arranging the barter so that both parties may be satisfied with the exchange. When goods are traded for goods, it is frequently difficult to adjust matters so that neither of the parties shall feel he is getting the worse end of the bargain.

Take the case of John and Bill again as an example. Suppose that John has a knife; it is new. Bill has a scout ax; it is a little worn. John wants a scout ax, but Bill's ax hardly seems worth his new knife. If John gives up his new knife for a worn ax, he will

feel dissatisfied with the trade. Now what can Bill give, together with the ax, in exchange for the knife. A compass? No, John doesn't want a compass. But Bill has an agate which John does want. So Bill agrees to add the agate to the ax, for he wants that knife. This case is a little different from the one in which they traded article for article directly, the knife for the scout ax. It has involved talking and bargaining.

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Fig. 294. Bargaining in India

Herodotus, an ancient historian, describes an example of barter very politely conducted:

"The Carthaginians are wont to sail to a nation beyond the Pillars of Hercules [Straits of Gibraltar], on the Libyan coast. When they come there, they transport their wares on shore and leave them, and, after kindling a fire, go back to their ships. Upon this signal the natives come down to the sea, and placing gold against the wares, return again. The Carthaginians then again approach, and see whether they have left sufficient. If it be, they take it and depart; should it, however, be not enough for their wares, they again go back to their ships and wait, and the other party brings more gold, until the strangers are satisfied. But neither party deals unfairly with the other, for the one touches not the gold till the value of the wares be brought, nor the other the wares until the gold be taken away."

2. Later, money came to be used in trade

Barter, as a way of trading, worked fairly well in ancient times, when people lived more simply and had few wants. But as communities grew larger, and people learned how to make many more things, difficulties arose in trading by means of barter.

For example, to exchange a tablecloth for a horse was difficult. A horse is worth more than a single tablecloth, but how could one divide the horse? A person who might want a horse would not be at all interested in part of a horse. Then, too, a man who wanted one tablecloth might not want six, and a horse may be worth that many. As trading developed and people learned how to make more things, they learned that each person who wishes to trade must have something that the other person wants. He must have just the right amount of it and must be able to deliver it. To trade successfully, all these needs must be met; hence difficulties arose in trading almost everywhere that people lived together.

Sooner or later, certain kinds of goods came to be accepted as the *medium* (means) *of exchange*. This simplified trading a good deal. For example, in Virginia in colonial times people used tobacco as we use money. The American Indians for a time preferred wampum (beads made from a kind of shell) as money. In some countries the skins or hides of animals were used. Cubes of pressed tea served as the medium of exchange in Tartary, and salt cakes in some of the western provinces of China.

These things were all considered valuable by the peoples who used them. They could be divided into different amounts more easily than could horses or sheep, and they were fairly durable. But they all had drawbacks as mediums of exchange, and gradually in all civilized places metals came to be the most acceptable article for this purpose. Tin was used in ancient Syracuse and in Britain; iron in Sparta. However, most people came to value highly the rarer metals, particularly gold and silver, and these became eventually the chief medium of exchange. They were beautiful in themselves, they would last indefinitely, and they were sufficiently rare to be desired.

So it was that in most countries *money* came to be used in buying. Money was made of gold, silver, nickel, copper, and even of unusual kinds of paper.

As communities grew larger and governments ruled over larger numbers of people, more and more trading was done. It became very important that the money used in trading should be accepted by all the people. To guarantee this, governments took control of the issuing of money. For example, they began to make

metal coins of certain standard, or uniform, sizes, shapes, and weights. On these they stamped the name of the government and the value of the coin. This helped to protect the seller and the buyer. For example, we feel confident that one silver dollar, stamped "one dollar" with the name "United States of America," really will be accepted by other people as worth 100 cents. So it is with a dime, a nickel, a quarter, a ten-dollar gold piece, etc.

Similarly, in England, France, Germany, and other countries which are well established the stamp of the government on coins guarantees its value. People who accept these stamped pieces of metal can be fairly sure that the pieces which look like gold or silver really are gold or silver. The invention of money saved a great deal of time. It kept people from being dissatisfied through feeling that they had overpaid or had been underpaid for their goods, because goods now came to be rated as worth "so much money."

We can be sure that ancient peoples had "standardized" systems of money because of the records that have come down to us from those times. Here, for example, is the way in which Marco Polo described Chinese money used about A. D. 1275.

"The money, or currency, they make use of is thus prepared. Their gold is formed into small rods, and being cut into certain lengths, it passes according to its weight, without any stamp. This is their 'greater' money. The 'smaller' is of the following description: In this country there are salt springs from which they manufacture salt by boiling it in small pans. When the water has boiled for an hour, it becomes a kind of paste, which is formed into cakes of the value of two pence each. These, which are flat on the lower, and convex on the upper, side, are placed upon hot tiles, near a fire, in order to dry and harden. On this latter species of money the stamp of the Grand Khan [the ruler of the country] is impressed, and it cannot be prepared by any other than his own officers. Eighty of the cakes are made to pass for a sixth part of an ounce of gold."

Salt cakes were of course not satisfactory, since they soon wore away. Even metals have certain drawbacks as money. They are heavy to carry about, and in spite of their hardness will in time wear away, becoming less valuable. So governments began to keep the metal money in vaults, where it would be safe, and to

issue paper money in its place. You are familiar with common examples of paper money. In the United States the government issues paper bills of convenient value; for example, one dollar, five dollars, ten dollars, twenty dollars, fifty dollars, one hundred dollars, five hundred dollars, and one thousand dollars. Every government nowadays issues paper money.

Printed on each paper bill there is a guarantee that if the possessor desires to have metal money in its place, it may be exchanged for gold or silver money. Examine a ten-dollar gold note, for example; on the face it says:

TEN DOLLARS IN GOLD COIN

PAYABLE TO THE BEARER ON DEMAND

On a five-dollar bill it may say:

THE UNITED STATES OF AMERICA

WILL PAY THE BEARER ON DEMAND

FIVE DOLLARS

In place of "The United States of America," there may be the name of a bank.

Of course, only the government and these certain banks are allowed to make either paper or metal money. For others to try to make copies of it is a crime, which is punishable by law. Such copies are called counterfeit money.

Money greatly simplified the business of trading. After money became the established medium of exchange, people spoke of "buying" and "selling" rather than of barter. They exchanged things for money, instead of things for things. Of course there are many places in the world even today where trade is carried on by means of barter. But money is used in all countries that we call "civilized."

3. Today much of our buying and selling is "on credit"

There is a third way of trading which is even simpler than that by the use of money; it is buying and selling "on credit." Today we see many people buying things in stores without using money at all. They merely say, "Charge it!" People in business order goods to be shipped to them from distant parts of the country, and frequently inclose no money. When they have goods "charged" they are buying "on credit"; that is, they promise to pay for the goods in the future. At the end of the month they receive a slip of paper called a "bill," stating the amount of money they owe the storekeeper for the goods which they have bought on credit.

Much of the trading of the United States is carried on in this way. Houses and automobiles are bought on credit; so are pianos and food. Everything, from pins and pickles to perambulators, may be bought on credit by tradespeople.

What is it that really makes trading on credit possible? Confidence! The one necessary thing is that the person who sells shall have confidence that the person who buys will pay. It is confidence in our government that makes us willing to accept paper money or coins which it has guaranteed. It is confidence which we have in friends that leads us to lend them money or other possessions. It is confidence in people generally that leads manufacturers and merchants to sell things on credit. Without confidence, business on credit cannot go on.

As each step in trade was taken, a greater and greater amount of trade was carried on. At first it was carried on between neighboring peoples, then between neighboring nations. It spread and spread, until now trade is carried on by all the industrial nations with the far corners of the earth.

We have now discussed the three main steps by which trade developed: first, in primitive times by barter — that is, by exchanging one thing for another; second, as civilization developed, by exchanging things for money; third, as civilization still further developed, another method, which is today used as widely as buying for money — namely, buying and selling things on credit. Furthermore, throughout history, as confidence grew among peoples, each step succeeded the former.

An Example of how Trade is carried on in the United States: how Food is brought from the Farms to the Homes

Having learned the chief ways by which trade grew up, we are now prepared to study more carefully examples of the vast system of buying and selling in the United States.

Because every community has at least one grocery store, we will take that as a starting place from which to examine this universal business of trade.

The grocery store: an example of the business of trade

On the shelves of even the smallest grocery store one can see things from all over the world: coffee from Brazil, spaghetti and olive oil from Italy, cheese from Switzerland, oranges from Florida and California, tea from India, and a large number of other things from many other countries and states. If we had to do all the work of marketing for a single meal, it would take months of travel to all parts of the world to assemble the different foods.

Fig. 295. Horse and wagon, automobile and truck, bring strawberries to town. Here some berries will be sold and others sent off by express to other towns and cities. (Courtesy of the American Agricultural Chemical Co.)

The grocer makes his living by buying and collecting these things in his store and selling them to us. Of course we pay him more than the goods cost him, because he brings them to us.

How has the grocer gathered his supplies of food? He purchased them from other people, who in turn have purchased them from many parts of the world. Because of a vast system of buying and selling, we find in one local store a wide selection of goods from which we can choose what we want.

Let us trace vegetables and dairy products back to their source. By this means we shall learn much about the ways of trade.

Some things the grocer may buy directly from farmers

Many grocers, especially in the smaller communities, obtain directly from the farmers their supplies of fresh vegetables, fruit, milk, butter, and eggs. Perhaps you have seen farmers unloading lettuce, string beans, peas, cabbages, carrots, cantaloupes, and other vegetables and fruits at the curb in front of the grocery store. Likewise you have seen the large cans of milk and butter from the dairy farm, and perhaps fresh eggs from the poultry farm. This is possible in small towns and medium-sized cities which are surrounded by truck and dairy farms. Indeed, in such places, on almost any day in spring and summer, you can see farmers selling their garden produce directly from their trucks to the customer on the sidewalk. But of late years, and in all the larger cities, the farmers generally sell directly to the retailer or storekeeper, who, in turn, sells to the housekeeper.

The grocer buys much of his stock from a wholesaler

In most of the communities of the United States, however, the retail neighborhood store buys the greater part of its supplies of food from large companies or wholesalers, whose warehouses are in the larger cities. At regular intervals the wholesalers' vans make the rounds of the retail stores within the city and of the stores in the small communities in neighboring towns and villages. No doubt you have frequently seen them unloading before these stores large boxes of canned peas, corn, or tomatoes, cartons of breakfast food, dried fruit, all sorts of crackers and wafers, large

baskets of bread, barrels of potatoes and onions, tubs of butter, large round cheeses, and great sacks of coffee, sugar, flour, dried beans, and rice. From these the grocer sells "half a pound of this" and "two pounds of that" to each of hundreds of housekeepers. The wholesaler, therefore, generally does not sell directly to the housekeepers. He sells eggs by the crate; lemons, oranges, grapefruits, and apples by the box; butter by the tub; and sugar by the barrel.

Why do the retail stores buy their supplies from the wholesalers? Why do they not buy directly from the flour mills, the breakfast-food factories, the meat-packing companies, and the canning factories? There is one good reason — most retail stores do not sell enough in any one year to make it pay to buy a large quantity at a time.

Take flour as an example. Flour is sold in carload lots by the companies that mill it from the wheat; they cannot afford to ship it in small quantities. But your local grocer supplies on the average only about sixty families, and hence he cannot afford to buy it in large quantities. All the flour that he would sell in a year would not make more than one and a third carloads. You can see, therefore, what a great expense it would be to him to buy a carload of flour, which would be all he could sell in nine months or a year. First, he would have to build or rent a large room in which to store it. That would cost money. Second, he would have to pay insurance on it to protect himself from loss in case of fire; that, too, means a loss of money. Third, he would lose the use of the money "tied up" in his carload of flour. He might have to borrow the money, and this would mean paying interest during the time he was holding the flour for sale.

Because buying sugar and beans and canned goods and breakfast food and other nonperishable food directly from the factory usually means buying them in carload lots, we see that the grocer would need to have a warehouse and extra clerks to care for it, and, in addition, would have heavy expenses for insurance and interest on borrowed money.

For such reasons as these the grocer usually prefers to buy from the wholesaler. From the wholesaler he can buy a smaller supply. This smaller quantity he can pay for easily, and a small store

will hold all he needs for the sales of a week or two. He knows that the wholesaler's vans will drive up every few days. Because the amount of goods he carries in his store is not large, he pays little insurance. For these reasons he can carry on his whole business with a small sum of money. The wholesaler, on the other hand, sells to many stores. Because he sells in larger quantities than the retailer, he can buy in carload lots.

The number of chain stores where groceries are sold is rapidly growing. The owners of these chain stores are both wholesalers and retailers. They *buy* in large quantities the goods they sell, just as do the wholesalers, and, distributing them to their stores, *sell* them in small quantities as do the retailers.

Where does the wholesaler get his stock of food?

But the wholesaler, too, must buy the food that he sells to the retailer. Where does *he* get it? To answer this question we must think for a moment of the different kinds of food. Flour, of course, the wholesaler can buy directly from the flour mills. Other manufactured goods too, such as cereals and canned goods, come from factories. But what about such perishable goods as eggs, apples, oranges, and potatoes? Some of them, like oranges and apples, are raised only in certain sections of the country and have to be shipped long distances to communities in other regions. How does the wholesaler secure the tremendous quantities that he sends each month to the many local dealers he serves? We do not have space in this book to illustrate all the ways in which this is done.

Consider first one example of the way in which such perishable products as eggs are secured by the wholesaler:

Mr. Smith, a *county collecting agent*, goes from farm to farm in Cleveland County, Oklahoma, and buys eggs from the farmers. He sells them to Mr. Jones, a *county shipper* in the near-by large town. Mr. Jones ships them to a large produce shipping company in Oklahoma City. This company sends them in car-lots to New York to be held by a broker, Mr. Adams. Mr. Adams sells them to a car-lot dealer, Mr. Brown.[1]

[1] Arthur B. Adams, *Marketing Perishable Farm Products.* Columbia University Press, 1916.

Thus the eggs pass through six hands before they reach the retailer! From the farmer to the county collecting agent, then to the county shipper, then to a large produce-shipping company, then to a broker in a large city, and then to a wholesaler, who sells them in carload lots. He sells them to the retailers in various communities, who in turn sell them over the counter to us, *the consumers*.

Consider, second, the way in which apples are bought and sold. Some wholesale apple companies send their agents directly out to the apple orchards on the farms. These men buy the apples on the trees and arrange for the picking, packing, and shipment of the fruit. Sometimes the farmers gather the crop, pack it, and ship it to central warehouses, where the wholesale companies buy it.

Grain, likewise, is sold to the wholesaler in a variety of ways. In some instances the farmers of a community join in a *coöperative* grain company. They build a warehouse for the grain, called a *grain elevator*. In other instances a private company builds an elevator and purchases the grain directly from the farmers near the town. In either case the grain-elevator companies sell the grain to flour-milling companies. These mills sell the flour to the wholesaler.

The public market: a place where people can buy directly from the producer or wholesaler

In many communities a housekeeper can buy perishable foods directly from the farmer or the wholesaler at a market which is run by the town or city government. This is called a *public market*. In small communities the market often consists of farm wagons drawn up to the curb on a business street. The farmer sells directly to the passer-by, and thus is saved the trouble of peddling his goods through the streets. At such a market the housekeeper can buy from many wagons instead of from one.

As the market grows, the city sometimes provides special buildings for it. Sometimes these markets are in fine, large buildings. The farmers themselves rent space in the market, or sell their goods to others who rent space. Meat and vegetables and

FIG. 296. The wholesale market in Chicago

fruit are sold in these markets. As the city continues to grow, larger and larger quantities of food, shipped from greater distances, are handled. In such a market, retail selling becomes less and less important. Slowly the market becomes a place for wholesale selling. Individual housekeepers are permitted to buy small quantities of food at such markets, but not many do it.

THE DIFFICULT QUESTION OF "PRICES"

In every exchange of goods the setting of a price is involved. When John exchanged his knife for Bill's scout ax, each thing was the "price" of the other. Whenever people barter or buy and sell with money or on credit, the act of trade takes place only when the buyer and the seller agree upon the price.

In most communities in the United States merchants set definite prices on their goods. As one goes about the stores of a city, he finds a price plainly marked on various articles. In most stores it is not possible to "bargain" with the merchant. He has fixed

the price of each of his articles, and does not regard it as a proper way to trade to accept less money from the customer than the price marked on his goods. Furthermore, if you compare the prices of a particular article — say, a pair of shoes of a certain quality — in various stores, you find that the prices are nearly the same. When the price of a certain quality of shoes is high in one store, it is high in all the others. Therefore, throughout the United States most buying and selling takes place at prices which have been set by the merchant.

If, however, you shopped in a city of China or some other country unlike our own, you would find a very different way of trading. There trading consists of the merchant setting a much higher price than he expects the customer to pay, and the customer offering a much lower price than he is willing to pay. The final price is set only after a long argument between the buyer and the seller; that is, when they can agree upon a price satisfactory to both. Sometimes both spend hours arguing over the price.

But what really determines the price of most articles? Let us consider an example.

What determines, say, the price of a pair of shoes? There are many factors, but three are most important. The first factor is the *cost* of the materials of which shoes are made and the cost of manufacturing and selling them. This includes the cost of the leather and other materials used in making them; the wages paid to workmen, clerks, and managers; the cost of the factory and of the machines used; the cost of shipping the shoes from the factory to wholesalers and from wholesalers to retailers; the cost of selling the shoes, including the selling by the manufacturer to the wholesaler and by the wholesaler to the retailer. With each sale new costs are added, including a profit first for the manufacturer, then for the wholesaler, and finally for the retailer. These are illustrations of the costs of making and selling a pair of shoes.

The second factor that helps to determine the price of a pair of shoes is the *supply*. Handmade shoes, for example, are produced in very small quantities at great expense. Their cost is much higher than that of machine-made shoes and for the two reasons indicated: first, the larger cost of producing the shoes; second, the small supply that can be produced.

There is a third factor — the *demand* for the shoes, as shown by the number of people who want them. Shoes are made and sold only because there is a demand for them. If there are few shoes manufactured and everybody wants to buy, the prices go up. If there are many shoes manufactured and few people are buying for one reason or another, the prices go down. The number manufactured usually depends upon the number of people who want them.

Three chief things, therefore, help to determine what we pay for the goods we buy: (1) cost of producing and selling them, including a profit for each of the sellers; (2) supply — quantity of goods available; (3) demand — number of people who want the goods. These enter into the cost of food, clothing, houses, automobiles, coal, oil, electric power, transportation, and communication — indeed, of everything we buy. The setting of prices, therefore, is at the very heart of all trade. In one way or another it enters into nearly everything we do throughout our lives.

How Banks help Trading in the Modern World

One other important aspect of trade remains to be discussed; namely, the part played in it by banks.

What is a bank? No doubt your first answer to that question is "A place where money can be kept safely." Yes, that is one important service rendered by banks. They are places of safe-keeping for money. They relieve us of the difficult task of guarding safely any money that we may have in addition to what we need for daily expenses. Many people, therefore, have bank accounts.

First, how were banks established in the communities of the United States? Almost from the very first years of settlement each community has had its bank. Frequently it started when people began to turn over their savings to the owner of the general store of the community to be kept for them in his safe or vault.

Some people in the community were thrifty, spent less than they earned, and so had a surplus to put away for safe-keeping. In earlier times it sometimes happened that storekeepers were trusted to keep safely large sums of money belonging to their customers

and neighbors. Other people in the community often needed to borrow money. Perhaps they were going to build a new house or an addition to their factory or to buy more equipment. For one reason or another they also formed the habit of going to the storekeeper to borrow.

It frequently happened, therefore, that as the business of keeping and lending other people's money grew, the money transactions of the storekeeper required so much time that he had to hire additional clerks to help him, and perhaps also to employ a manager to take his place part of the time in the store. Perhaps he became so busy with the affairs of handling and lending money that he turned the store over to his manager and another building was secured for himself and his clerks, where the borrowing and lending transactions were taken care of. He called this building a *bank*, and he himself was no longer known as a storekeeper but as a *banker*.

Fig. 297. One of the great banks of the United States. (Courtesy of the National City Bank)

Out of these two facts — that some people had more money than they needed and others less money than they needed — arose the business of lending and borrowing money. This business developed our banks. Today several of our largest banking firms, such as J. P. Morgan and Company and the National City Bank, grew out of trading establishments. J. P. Morgan and Company grew out of a dry-goods business, originally owned by George Peabody. The National City Bank developed from another dry-goods company, owned in the 1700's and 1800's by Moses Taylor and his partners. So much for a brief consideration of the first question; namely, how banks came into existence.

The second question we must study is, Who owns the money

in the bank? Of course the banker and his partners own some of it, for no doubt they have put some of their own earnings into the bank. But most of it is owned by the depositors, the many people who have turned their money over to the banker for safe-keeping. This point is very important to remember because of the use that is made of the money.

But there is a third important question, What happens to the money in the bank? Does it merely remain in the vaults? No, a service is rendered by banks far more important than keeping the savings of people. Banks invest money and thereby make more money for people. They lend money and thereby help trade. Because of savings accounts and other deposits, banks accumulate large amounts of money, which they lend to people who desire to build houses or factories, or start businesses. So important a part do banks play in farming, home-building, and manufacturing, that it is doubtful whether our great national and international trade could go on today without our banks. When a bank lends money, it asks in payment a small percentage of the money lent. In this way it earns additional money both for the depositor and for the banker. In order to understand how this can happen, we must first understand *interest.*

FIG. 298. At Lincoln, Nebraska, is the smallest bank in the United States, a wooden building 16 by 20 feet. How does it compare with the bank in your town? (Photograph from Keystone View Co.)

How does it happen, for example, that people are willing to deposit their money in the bank? First, because they have confidence in the banker and feel sure that the money will be safe and will be returned to them when they ask for it. But there is a more important reason: the bank pays them interest. Suppose, for example, a man deposits $100 and leaves it in a savings bank for a year. At the end of the year he may draw it out and receive

from the bank in addition, say, $4 more. This $4 is interest, which the bank pays the man for the use of the money during the year. In that case the interest has been 4 per cent. (The $4 is 4 per cent of $100.) Sometimes banks pay only 2 per cent interest, sometimes 3 per cent, sometimes even more than 4 per cent.

Why is the bank willing to pay the man for the use of his money? Merely because the bank can lend the man's money to other people who will pay the bank a larger interest than it pays the first man; and thus the bank itself makes a profit.

Next remember that banks have hundreds, sometimes thousands, of depositors. Even though each one leaves only a small amount of money in the bank, the total amount makes a very large sum. Indeed, some of our largest banks have deposits amounting to hundreds of millions of dollars. Some of this money is lent to business men who wish to use it in developing their businesses. In the course of a year these men pay the bank a considerable amount of money in interest. In this way banks make very large sums of money.

With these facts in mind we are prepared to understand how banks help trade. They help it by lending business men money so that their businesses may grow. Most business men today use much borrowed money in carrying on their buying and selling of goods. A large amount of this money they borrow from banks.

Summarizing what we have learned about Trade

1. In the earlier chapters we saw that our civilization depends upon farms and factories, transportation and communication. In this chapter we learned that it also depends upon a system of trade. Of the 41,000,000 workers in the United States approximately one tenth are earning their living in trade.

2. We learned that the present system of buying and selling grew out of a very simple system of barter. Barter was used in earlier times, when goods were exchanged for goods. Many peoples in countries different from our own still exchange goods by means of barter. As modern civilizations developed, however, various kinds of money came to be accepted as providing a more convenient way of buying and selling. Finally we found that,

with the accumulation of large amounts of money and with the growth of confidence among people, trading came more and more to be done on credit.

3. We studied examples of the way in which goods are bought and sold in a large country like the United States; namely, how food is brought from the farms where it is produced to the homes where it is consumed. We studied the grocery store as a special example of trade, and saw that the grocer sometimes buys his food directly from farmers, but that more frequently he buys it from wholesalers, who in turn secure it directly from flour mills, food factories, and farmers.

4. We saw that one important aspect of trade was that involved in the setting of prices. We learned that in setting prices, as well as in the production of goods, countries like the United States appear to have more convenient systems of trade than do some other countries. This was illustrated by the examples of definite setting of single prices for goods in the United States and other industrial countries, and the practice of arguing, or bargaining, over prices in other regions. We learned that the price of articles is determined by the cost of producing them, the ease with which they can be produced in large quantities, the number of people who want them, and the profit made by the various persons producing and selling them.

5. Finally, we saw that banks play a very important part in trade in the modern world. They not only guard the savings of people but they pay interest on such savings, and in turn they lend sums of money to private citizens. But the largest amounts are lent to business concerns. Banks, therefore, help trade by making large amounts of capital available for manufacture and merchants, and by helping individual citizens by lending money to them or earning money for them on their savings. We learned a most important fact in this connection; namely, that most of the money in banks is not owned by the bankers but by the many individuals who deposit their surplus money in the bank. Thus banks, because they accumulate large amounts of money, are able in turn to make great profits, part of which is returned to the depositors as interest.

INTERESTING READINGS FROM WHICH YOU CAN GET ADDITIONAL INFORMATION

Books

Bishop, A. L., and Keller, A. G. Industry and Trade. Ginn and Company, Boston, 1923.

Chapter XXXI contains a short account of the place of trade in modern life.

*Crissey, Forrest. The Story of Foods. Rand McNally & Company, New York, 1917.

Chapters XXI and XXXII give a description of what the wholesaler and retailer do in helping get food to you.

*Hill, Howard C. Community Life and Civic Problems. Ginn and Company, Boston, 1922.

Chapter XIV (The Exchange of Goods) clearly presents different means of exchanging goods.

*Keir, Malcolm. The March of Commerce (Volume IV of The Pageant of America). Yale University Press, New Haven, 1927.

Chapter XIV (American Money) and Chapter XV (Banking).

*Marshall, Leon C. The Story of Human Progress. The Macmillan Company, New York, 1925.

Chapter IX (Multiplication of Powers through Trade: Money, the Language of Trade) and Chapter XII (The Coöperation of Specialists).

Marshall, Leon C. Readings in the Story of Human Progress. The Macmillan Company, New York, 1926.

Chapter IX (Multiplication through Trade: Money the Language of Trade) and pages 426–432 (Improving Our Marketing Machinery).

Magazine Articles

*"The Geography of Money," *National Geographic Magazine*, December, 1927, pp. 745–768.

An interesting article showing the many things that are used for money in different parts of the world. Good illustrations.

CHAPTER XXVI

MANUFACTURING, TRANSPORTATION, AND TRADE DEPEND ON LARGE BUSINESS AND INDUSTRIAL ORGANIZATIONS

In this book we have studied examples of the important factors that made possible our high standard of living — our fortunate location in a stimulating and productive climate, our vast territory and wealth in natural resources, our large and varied population, and our use of scientific knowledge in the invention of engines and machines and in their use in manufacturing, transportation, and communication.

Wonderful as they are, these factors alone could not have made us the powerful and wealthy nation we are today. One other thing was needed; namely, new ways of doing business so as to make possible the new ways of producing and distributing goods. The *mass production* of steel, coal, oil, power, and manufactured goods could not have developed on so large a scale as it did without corresponding *large-scale* ways of securing money and doing business.

As you have read about the development of our great steel companies, coal companies, railroad systems, telegraph and telephone lines, did it not occur to you that a great deal of money must have been necessary in order to build and to operate any one of these? How was the money secured? Not from one or two individuals, for until recent years there were few men who were wealthy enough to invest millions in a single business. Who, then, supplied the money?

In the very period in which men succeeded in inventing efficient machines to do their work they also discovered more efficient ways of getting money and of organizing business. No single example is more important than that of the *corporation*. Today most of the manufacturing, mining, and transporting of people and goods is done by corporations. Corporations can gather together large amounts of money. Through corporations men discovered a way

OUR BILLION-DOLLAR CORPORATIONS[1]

United States Steel Corporation
Southern Pacific Railroad
Pennsylvania Railroad
American Telephone and Telegraph Company
New York Central Railroad
Standard Oil Company of New Jersey
Union Pacific Railroad
Atchison, Topeka, and Santa Fe Railroad
General Motors Corporation
Ford Motor Company

to finance railroads, steel companies, and other enterprises which required greater sums of money than they themselves possessed.

Today in the United States there are ten billion-dollar corporations — that is, ten business organizations each of which is worth more than $1,000,000,000. A billion dollars! Few people can really comprehend such a large sum of money. An expert bank teller working eight hours a day, Sundays and holidays included, and counting one bill each second without rest would take almost 100 years to count 1,000,000,000 one-dollar bills.

FIG. 299. In this picture the artist imagines the business man studying the factories of corporations in which he has invested money. (Courtesy of the National City Bank)

Seven of these organizations furnish transportation. They are either railroad corporations or automobile corporations. One furnishes telegraph and telephone communication. Another, the Standard Oil Company of New Jersey, furnishes one of our basic fuels. The tenth, the United States Steel Corporation, furnishes another of the important materials upon which our civilization is dependent.

The story of corporations, like that of machine manufacturing and transportation, is not an old one. In 1865 corporations were

[1] Many of these organizations are called "companies," but they are really corporations.

almost unknown. At that time *all* the manufacturing industries of the United States taken together were not worth more than $1,000,000,000, and most of these consisted of small establishments owned by single persons or by two or three partners.

In the short space of 30 years a great change came about. By 1890, in each of the leading industries, the majority of the small establishments had been combined into large companies. Many of these are corporations. Corporations have become so important in the business world, therefore, that we must understand clearly what they are and how they are formed.

A corporation is merely a special kind of company, in which shares are owned by many people, and in which business is done through elected directors and officers. Perhaps the clearest way to study corporations will be to hear the story of how one small business grew into a large corporation, and then to take up the growth of several of our well-known corporations.

An Example of the Growth of a Corporation

The first step: forming a partnership

This is the story of how Henry Chase's little delivery business became the Chase and Mead delivery corporation. It began when Henry Chase was a youth in high school, working as an extra delivery boy for the neighborhood grocer. Henry had made quite a little money delivering packages late afternoons and Saturdays, but it was difficult to arrange his time satisfactorily. Between five and six he had to practice his violin lesson, and that was when late orders needed quick delivery. On Saturday morning, one of the busiest times in the week, he had to take his lesson. The grocer was dissatisfied, and it was necessary to make some new arrangement.

So Henry went to one of his friends, Robert Mead, and after some talk, they decided to go into the delivery business as partners. Henry alone could not manage to satisfy the grocer's delivery needs, but it seemed probable that by forming a *partnership* the two boys not only could do the grocer's extra delivery but might also get some additional business.

In their discussion the boys found that each had something to invest in the business. Henry had a bicycle and the delivery job. Robert had no bicycle, but he had $20 in the bank and a telephone in his house. They finally agreed upon all the necessary details — the time each should work, the way they would divide the money, how much they would charge for deliveries, and so on. With part of Robert's money they had cards printed announcing their new

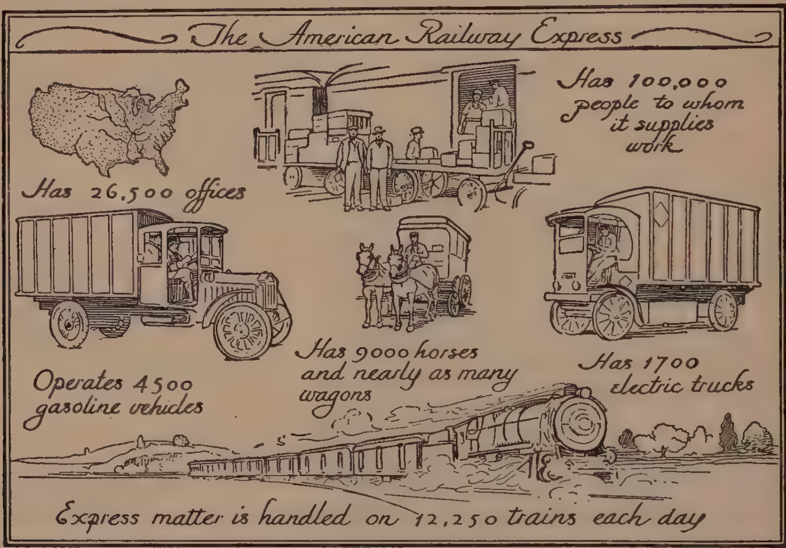

FIG. 300. This summarizes the large amount of business done by one great delivery service, the American Railway Express. Can you imagine how this large corporation might have grown from a small business like the Chase and Mead Delivery Service? (Courtesy of the American Railway Express)

business, the "Chase and Mead Delivery Service." These they distributed to storekeepers and homes in the neighborhood. They went to the county clerk's office and asked to have their names registered as partners doing business under the title of "Chase and Mead Delivery Service." It cost 25 cents to have this done. The boys worked hard, and soon their business grew. They delivered a great many packages. They went shopping for people in the neighborhood, and took children home from school.

Soon they discovered that they needed more equipment. One bicycle was not enough. Robert Mead's mother was annoyed by

the constant ringing of the telephone, and it looked as if they would have to open a separate office in the garage, with a telephone and a boy to take orders. They would not be able to keep up with the demand for deliveries unless they could enlarge their business in these ways, and the boys in the next block would be starting up a rival delivery service if they did not take care of the orders promptly.

But to enlarge their business would require much more money than they had. The boys talked the matter over with Henry's father, who reminded them that they should save regularly some of the money that they made and reinvest it in their business. "Every business," he said, "has to expend large amounts of money for wages, keeping up equipment, and so on. If a business is to succeed, all expenses must be met and some money laid by for enlargement of the business and to offset losses."

After looking over their accounts, Mr. Chase decided that he would lend the partners some money, for it looked as though the business would keep on growing. But he wanted some assurance that the boys would pay back the loan. He also wanted his money to be earning interest, for by investing it in other ways he could make from 4 to 8 per cent. What inducements could the boys offer him to invest his money in their business?

Several plans were talked over, and it was finally decided to make Mr. Chase a third partner in the business. He would do no work, of course, but he would put his money into the business if Henry and Robert would share profits with him and promise to work hard. By this time, both boys had graduated from high school; so they agreed to spend all their time working at the new business.

Accordingly the partnership was extended to include three persons. Again they went to the county clerk's office and had Mr. Chase's name added to their certificate, though they continued to call their business the "Chase and Mead Delivery Service."

With the new capital (Mr. Chase's money), they installed a telephone in the garage, hired a boy to answer calls, and bought another bicycle. Steadily their business grew. They were called upon to deliver bulkier articles, and consequently purchased an old Ford truck. It became necessary to hire a garage of their own;

so they rented a shed close by, which served both as office and garage. As the business grew, a larger place had to be rented, a bookkeeper employed to keep the accounts, and part-time delivery boys hired. They had to spend more money for advertising and for equipment. Finally they built a fireproof garage and office.

The second step: forming a corporation

Their business kept increasing. They decided also to go into the business of moving furniture, even though this necessitated buying expensive moving vans and enlarging their garage. In order to do this, they were compelled to borrow money. This time instead of securing it from individuals, they went to the local bank. By that time their business was known as a safe and prosperous one. So the banker lent them money, taking from them a note — that is, a promise to pay the money at a stated time in the future — which they finally paid back to him with interest.

At last the Chase and Mead Delivery Service had so many demands made upon it by people in neighboring towns that the three partners thought it would be wise to open branch offices in other towns. To do so would require a very large sum of money, certainly several thousand dollars. Mr. Chase decided that he could not invest more money in the company, and the boys knew no way by which they could obtain as much as they needed from any other one person, who might be taken into the company as a fourth partner.

After much discussion they did what most men do who want to expand their businesses and to get more money without paying interest to the banks: they decided to form a *corporation*. They talked to a number of friends and relatives about investing their money in the new corporation. Like most people, they knew little about the way a corporation was formed; so they went to a lawyer for help. He had them ask the people who were considering investing some of their money — Robert's cousin, the grocer, and the banker — to come together for a meeting. At this meeting they voted to form a corporation. Then the lawyer asked them to fill in a blank called a "certificate of incorporation," which they had obtained from the office of the secretary of state in the state capital. This certificate explained the purpose and plan of the

proposed corporation, and gave the names of the officers, the amount of money to be invested in the business, etc. At this meeting, therefore, it was necessary to elect officers and to decide many matters.

The first matter to be decided was how much money they needed to raise and how much each person would invest. Henry and Robert had prepared a written statement, which showed the condition of their business:[1]

Equipment on Hand	Capital		Profits in Past Years	
1 sheet-iron garage	Cash in bank	$833.45	First year . .	$300
5 bicycles	Money owed the company	88.72	Second year .	800
2 used Ford trucks		$922.17	Third year .	2000
1 Acme moving van				
Office equipment				
Advertising matter, etc.				

Purposes for which Money from Sale of Stock will be Used

1. To open branch and supply equipment, including advertising etc.
2. To increase equipment in home office. A new van is needed and a larger garage and office.

"How much money do you want?" the banker asked.

"We want $8000. We think that with $8000 we could install the new office, buy the trucks that we need, hire the proper help, and increase our business twofold."

"How do you plan to raise this money?"

"We plan to issue stock to the amount of $20,000; that is, to form a corporation known as the 'Chase and Mead Delivery Service, Incorporated,' with a capital stock of $20,000. Our statement shows that last year we made a profit of $2000, which we divided equally among the three partners. We figure that after we have expanded, our profits will be more. With increased delivery facilities and a branch office, we shall be prepared to handle at least 50 per cent more business. If we sell stock amounting to $20,000, we can assure every person who buys stock 5 per cent of the amount he lends us, for the use of his money, and probably can pay him actually 7 or 8 per cent.

[1] The first two columns of the table illustrate what is meant by "capital."

"When we took my father in as a partner four years ago, he invested $300. He has never done one bit of work, yet he has made over $1000 out of that $300 in three years. That's what he got for helping us out when we needed it. Now we need more money, and we think there will be plenty of people who will be willing to do what he did three years ago."

"I see," said the banker. "You consider your good name to be worth a great deal."

"Certainly," said Henry. "Around our part of the state the 'Chase and Mead Delivery Service' means something. It means promptness, reliability, careful handling, fair prices. We have many friends. Our 'good will' is worth *more* than a $20,000 investment."

"How do you plan to divide this stock?"

"We expect to issue 200 shares of stock to sell at $100 a share. We three partners will turn over our present business, our equipment, and our good names to the company about to be incorporated. In exchange for our business, instead of money payment, we will take shares of stock in the new company.

"We figure that our present business is worth $12,000, and we will accept 120 shares of stock in the corporation as equal to $12,000. That gives us 40 shares apiece and leaves 80 shares to be sold."

The banker was a little reluctant, but Mead's cousin and the others were both sure the business was going to grow. Mead's cousin agreed to take 10 shares, for which he would pay $1000, on the understanding that he should be the manager of the new branch. The grocer said he would take 20 shares, $2000 worth. He had faith in the young men, for he knew them to be hard workers, always out for business. The banker finally took 4 shares, and the lawyer took 2. Henry Chase had saved up some money, and he bought 4 shares, in addition to the 40 shares to which he was entitled as one of the three original partners.

These people, called the incorporators, then elected Henry Chase president, Robert Mead treasurer, and Chase's father secretary. They also named these three to be directors of the company. The directors were to decide the various matters that came up, and lay them before the stockholders at the regular

annual meeting to be held every April. At the first stockholders' meeting the regular elections were to be held and the same offices filled. The others, as regular stockholders, were entitled to go to all meetings of the stockholders and to vote on all questions laid before them by the directors, such as declaring how much money they could afford to pay out as dividends from the profits made each year.

This all being agreed upon, they signed their names to the certificate of incorporation and sent it to the office of the secretary of state for his approval. When they received word that he had authorized it and had put his seal upon it, they were duly incorporated as the "Chase and Mead Delivery Service, Inc.," and they set about issuing 200 shares of stock, each valued at $100. The stock certificates looked a good deal like bank notes.

They told all their friends about their new company. Some other people who knew the boys bought shares. One woman, whose furniture they had moved to a distant city, bought a share. One man, who had never seen the young men, had seen their signboards and had heard people speak of them. He decided to take a chance and buy a couple of shares in the new corporation, just to see how it would turn out. The principal of the high school they had attended bought a share. A rival bank bought 10 shares, hoping to get some business from the company.

So all these people became business partners of Henry Chase and Robert Mead. The new corporation proved to be a success.

When the corporation needs to enlarge its business, the directors will write again to the secretary of state for the necessary blanks and will issue more stock.

The story illustrates how partnerships and corporations are formed to increase the capital in a business

The story of the way in which Henry Chase's little part-time delivery job grew into the Chase and Mead Delivery Service, Inc., illustrates why business men take in partners. The usual reason is that which is shown in the story — that people may get money with which to increase their business. Henry Chase took in a partner, Robert Mead, who invested something in the company.

When their business demanded a larger investment they took in another partner, Mr. Chase. When they needed still more money in sums larger than any individual that they knew could invest, they formed a corporation. The corporation differs from the partnership in two important ways: *first,* there are many owners instead of two or three; *second,* the company is managed by a few directors, elected by the owners of stock, who choose the managers and other officers.

One important fact should be remembered from this story of how a small business grew into a corporation: corporations provide the way by which larger amounts of capital can be acquired than can generally be secured by individual persons or even by partners. As business grows, the capital is increased.

If Chase and Mead Delivery Service, Inc. wishes still further to increase its capital, it can do so in two ways: by selling more *stock*, as it did when it became a corporation, or by selling *bonds*.

We have seen that the people who buy stocks become part owners of the company. They have a share in running it. Their number of votes at stockholders' meetings depends on the number of shares of stock they own. If the company succeeds, they get a good interest on their money; but if it fails, they may lose what they invested.

But bonds are different from stocks. When a person buys a bond, he lends money to the company in return for a bond or receipt. A bond is a promise made by the corporation to pay back at a definite time, say within five, ten, or twenty years, the money received from the person who lends it. In addition, it is a promise to pay interest on the money, usually from $4\frac{1}{2}$ to 7 per cent, just like interest on any other sort of loan.

The owner of a bond is not a part owner of the corporation, and he has no right to vote on its management. He gets the rate of interest stated on his bond, and no more. A stockholder may receive a smaller amount of money from the corporation each year than a bondholder, or he may receive a larger amount. The return on his money depends upon how large the profits of the corporation have been in that year.

This story illustrates one way in which corporations grow. It also illustrates two ways by which corporations can get money

when they need it for enlarging their business — by selling stock and by selling bonds. With this example in mind of the manner in which small partnerships may grow into corporations, let us study briefly a few of our larger corporations today.

Four Examples of the Growth of Large Corporations in the United States

In 1865 there were few large corporations in the United States. Nearly all manufacturing was done by small businesses, each owned by an individual or by a few partners. Steel was manufactured by a great many little companies, coal was mined by many little companies, oil was produced in the same way. Even the railroads that joined the East and the West were still owned by many separate companies.

By 1910 all of that was changed. Most of the industries were carried on by large corporations. The United States Steel Corporation, for example, owned a large share of the steel mills of the country. Hundreds of little railroad lines had been joined together in a few large railroad corporations. The International Harvester Corporation owned most of the farm-machinery companies. Even the business of buying and selling goods had changed. Many small partnerships had become large corporations.

To learn how this change came about, we should read at least brief stories of how several kinds of corporations were formed. Let us take four: one from the steel industry, one from the railroad industry, one from the motor-car corporations, and one from the chain stores.

The first example: the United States Steel Corporation. How a small iron mill became one of the greatest corporations in the world

In 1858 Andrew Kloman and his brothers started an iron forge in Allegheny, Pennsylvania. Their plant was worth $5000. This was a *partnership*.

In 1859 Henry Phipps became a new *partner* and put money into the firm. It was then called Kloman & Phipps. The capital was increased to $6600.

In 1864 Andrew Carnegie became a partner, and the firm was called Carnegie, Phipps & Company. The capital was increased to more than $50,000.

In 1865 This company was united with another firm in which Carnegie owned a large share. The new firm was known as the Union Iron Mills Company. The capital was increased to between $250,000 and $300,000.

In 1874 Some of the firm members of the Union Iron Mills Company formed a partnership with men who owned stock in certain *railroads*, thereby guaranteeing their iron company more business.

In 1881 The Union Iron Mills Company and other companies — railroads, coke manufacturers, etc. — were combined as Carnegie Bros. & Co. The capital was now set at $5,000,000. They bought a competing steel plant at Homestead, Pennsylvania.

In 1882 Carnegie Bros. & Co. bought a large amount of stock in the H. C. Frick Coke Company and acquired coal lands and coke ovens.

In 1892 (1) The Carnegie companies were reorganized into the Carnegie Steel Company. The capital was increased to $25,000,000.

(2) The Union Railroad was built to aid the management of plants around Pittsburgh.

(3) This new company also purchased a railroad connecting Pittsburgh and Conneaut Harbor on Lake Erie. Ore docks were erected at the latter point.

(4) The new company organized another company to build a fleet of boats to transport their ore across the Great Lakes.

In 1900 The Carnegie Steel Company joined with other companies and formed the United States Steel Corporation, with a capital of $1,404,000,000. This great corporation now owned 149 steel works, vast ore, coal, gas, and limestone properties, over 1000 miles of railroads, and over 100 vessels on the Great Lakes.

In the next 25 years the corporation grew even larger. In a recent year it owned 24 railroad companies, 123 steamers, 130 iron-ore mines, 3022 acres of coal mines, 65 coking plants, 1165 gas wells, 202 oil wells, 17 gas-compressing stations, 4 gasoline plants, 1200 miles of gas-pipe line, and 64 ore docks.

Notice three things about the development of the United States Steel Corporation.

First, it grew bigger and bigger. It took in more and more separate companies, until finally nearly $1,500,000,000 worth of capital was invested in it.

Second, it not only owned iron and steel mills, but it also owned and operated iron-ore mines, coal mines, coking plants, railroads, lake steamers, docks, oil wells, and gas wells. Why? Simply because it was cheaper for the great single corporation to own and operate them than to buy these products and services from other smaller companies. So little by little the corporation took into one great organization the companies on which it was dependent for raw materials, for fuel, and for transportation.

Third, to collect such large amounts of capital as were needed to own and operate all these enterprises, it was necessary to form a corporation. No partnership could furnish such a large amount of capital. Furthermore, it necessitated working out very carefully a method of organizing the business. Hundreds of managers were needed, thousands of clerks, tens of thousands of skilled and unskilled employees.

The United States Steel Corporation, therefore, is not only an example of the way partnerships have grown into corporations but also a striking example of what we mean by "big business." During the past 25 years the phrase "big business" has come to be used in connection with great industrial corporations. All the billion-dollar corporations enumerated at the beginning of this chapter are excellent examples of it. Each of those businesses is conducted on an immense scale, and great amounts of capital are gathered in one organization. The words "big business" will therefore apply to each of them.

A second example: the combination of many small railroads into a few great railroad systems

In Chapter XV, figure 166 shows that most of the railroads of the United States are combined into a small number of great systems. Today you can ride on a New York Central or a Pennsylvania train from New York City to Chicago without changing

cars. At Chicago you can change in the railroad terminal and travel from there on another train — for example, the Rock Island or the Santa Fe — 2000 miles and more to the Pacific coast. This transcontinental journey, made on but two railroads, would not have been possible 75 years ago. It is possible today because great national railroad corporations have been formed through combining the hundreds of little railroads which existed formerly. In Chapter XV you read the story of how this was done by such business men as Cornelius Vanderbilt. You recall how the width of the track, locomotives, and cars were standardized, how more tracks were laid, and how scores of little railroad lines came to be owned by one corporation.

The steps in the development of each of these railroad corporations were much like those taken in the formation of the United States Steel Corporation. In the first place, as the companies needed more capital they formed corporations and issued stocks and bonds to get more money. In the second place, like the steel company, they bought up other industries. The railroads needed huge quantities of steel for rails, locomotives, cars, etc.; so their stockholders and officers bought stock in steel companies. Many owners of steel-company stock also owned railroad stock. So the steel companies and the railroad companies worked very closely together. The railroad managers saw, furthermore, that they would need great amounts of coal; so they purchased a vast number of coal mines in Pennsylvania, West Virginia, and other parts of the country. Some of the railroads saw that cheaper power could be had by using electricity; so in many places they built hydroelectric power stations. Some of them needed transportation on the Great Lakes; so they built their own lake steamers and docks. Today they own many industries other than railroads. In fact, most of them own stock in all the important industries upon which the running of railroads depends. Thus some of the great railroad corporations came to be worth billions of dollars.

In the third place, the development of these railroad corporations required the same elaborate organization that was necessary in the case of the steel corporation. These railroad corporations, too, are examples of "big business."

A third example: a vast motor-car corporation

One of the largest corporations has grown up in the last 30 years from a little one-man repair shop. Today it employs 150,000 men. It owns and works its own iron mines. It transports the iron from its ore mines to its own steel plants by means of its own lake steamers and railroads. It owns coal mines in several states. Instead of purchasing steel from the steel corporations it makes its own iron into steel by means of its own blast furnaces, coke ovens, foundries, and power plants. It constructs practically every article needed in the making of an automobile — the steel frame, the wheels on which it stands, the body, the plate glass, the cloth and artificial leather used in upholstery, the engine and all the other operating parts of the machine. It owns forests of lumber and the sawmills which turn out wooden parts for the automobile. It manufactures its own cement and paper, and operates a world-wide sales service through 52,000 branches in every civilized part of the earth.

This motor-car corporation also illustrates the three features which we found to be true of the steel corporation and of the railroads: *first*, it commands hundreds of millions of dollars of capital; *second*, it owns and carries on all the related businesses which make articles used in the completed automobile; *third*, it maintains a complicated organization, employing many managers and skilled and unskilled workers.

The fourth example: the chain stores — corporations which buy and sell in large quantities

In 1879 F. W. Woolworth, a poor and ambitious clerk, opened his first five-and-ten-cent store in Utica, New York. In the first year of business he sold $6750 worth of articles for five and ten cents each. In 40 years he was the head of a great five-and-ten-cent corporation which owned 1038 stores and which in one year did business amounting to $107,000,000. Can you imagine how many nickels and dimes were paid over the counters of these stores to make up this great sum of money?

In 1912, about 33 years after Mr. Woolworth opened his first store, the American business world read the announcement that

a great corporation had been formed to take over the 318 five-and-ten-cent stores of F. W. Woolworth, the 112 stores of S. H. Knox and Company, the 96 stores of F. M. Kirby and Co., the 53 stores of E. T. Charlton and Company, the 15 stores of C. W. Woolworth, and the 2 stores of W. H. Moore. More than 500 stores scattered over most of the states of the country were joined together in a great "chain."

Why was this done? Chiefly for one reason. In the combining of 500 stores a great amount of capital could be gathered into one corporation, and it takes a vast amount of capital to buy articles in quantities large enough to be purchased from the manufacturer at very low prices. By buying articles at low prices in great quantities the chain stores are able to sell many of their articles at much lower prices than other stores. Consider one example from the business of a great chain-store corporation.

A buyer for Woolworth's had brought to his attention a certain popular finger ring, which retailed at 50 cents. He told the manufacturer he wanted the ring for the Woolworth stores to retail at 10 cents.

"Absurd," was the manufacturer's comment. "I can't make the ring so you can sell it at 10 cents. Anyway, I am selling plenty as it is — more than 450 dozen this year."

The buyer said he could use a great enough quantity to make the deal profitable for the manufacturer. The rings were produced. Woolworth's sold them at a dime each. The manufacturer made more money than ever before, and the people got genuine rings at 10 cents — the same in every way as those sold for the higher price.

The buyer had said he could use a great quantity. He actually did use 60,000 dozen during the year. Quite a difference from the 450 dozen that the manufacturer thought represented a big business![1]

Another example:

A Western department-store proprietor, when in New York, visited Woolworth's Fifth Avenue 5-and-10-cent store on the invitation of another business man, who said it was something he should not fail to see.

On one of the 10-cent counters he noticed some little Japanese vases of exquisite pattern, which were selling for 10 cents. He was attracted because he knew that kind of vase. He looked the vases over carefully,

[1] *Fortieth Anniversary Souvenir.* F. W. Woolworth Co.

expecting to find some defect that would account for the low price. To his amazement he found them perfect. The same vases retailed in his own store for 75 cents.

The profit gained by the retailer who sold these vases at 75 cents doubtless was fair. He based his selling price on his buying and overhead cost, just as Woolworth's does. The difference was that he bought a few vases for one store, while Woolworth bought many for more than 1000 stores.[1]

Many corporations of chain stores have grown up. They, like the steel corporations, the railroad corporations, and the motor-car corporations, are examples of "big business." They accumulate great quantities of capital, buy goods at low prices, and sell them at low prices and in great quantities. No doubt several of these chain stores are represented in your town.

Nearly Everything we use today is manufactured by Corporations

The conditions of 50 years ago are entirely changed. Rarely does the shoemaker, the hatmaker, the shirtmaker, even the dressmaker, make and sell his goods through his own establishment. Today most of our manufacturing is carried on by corporations. You cannot pick up a newspaper, a magazine, or a government report without reading items dealing with corporations. Our breakfast foods are made, stored, sold, and brought to us by corporations. Pins and automobiles alike are manufactured by corporations. Steel, oil, coal, and all their by-products; cloth for our clothing, the garments themselves; furniture for our houses; meat and groceries for our table — almost everything is produced, transported, and sold by corporations.

Not only is that true, but the corporations in each line of business are growing larger as small ones are combined into greater ones. Correspondingly, the number of partnership companies and small corporations in each line of business is decreasing. For example, Pittsburgh used to have twelve daily newspapers, each produced by a separate corporation. Recently a number of these corporations have combined, and now there are only five news-

[1] *Fortieth Anniversary Souvenir.* F. W. Woolworth Co.

papers published there. In Chicago, San Francisco, New York, and other cities similar combinations of newspapers are being effected. The same thing is happening in the manufacture of automobiles. Fifteen years ago there were about 200 manufacturers. Today there are only about 50, and two of these 50 corporations produce two thirds of all the automobiles made. Through the invention of power-driven machines, the Industrial Revolution made possible the mass production of many kinds of articles. Through the invention of the *corporation*, mass production was made a reality. Knowledge of how to make engines and machines and to manufacture things in large quantities cheaply could not alone have brought about mass production. Huge amounts of capital were needed to carry this on.

These examples of "big business" help us to understand how our great industrial corporations — the few billion-dollar ones and the many smaller ones — came into existence. This combining of large amounts of money builds up great industrial organizations, which need thousands of people to work for them. In a little more than 100 years this building up of corporations has helped to make a small country of farmers become one of the world's largest countries, with more than half of its people city dwellers.

As we said at the beginning of this chapter, the great territory of the United States, with its large amounts of land, iron, coal, and other natural resources, could not alone have produced our modern civilization. Factories had to be erected, power-driven machines installed and run. Millions of hands were needed, but millions of dollars' worth of capital were also needed by single industries and businesses. *To provide the capital* for farming the land, mining the ore, building and running the engines and machines, intelligent business men devised the corporation.

By means of the corporation many persons, each one having a small amount of money, are enabled to invest it usually at a greater profit than they would have if the money were deposited in a bank and drew interest. When put together, all these small sums of money from many people provide a large capital. With such a capital, work can be done by more efficient methods, and goods can be manufactured in greater quantities. Thus, the cost of goods to both manufacturer and consumer can often be reduced.

INTERESTING READINGS FROM WHICH YOU CAN GET ADDITIONAL INFORMATION

Books

Bishop, A. L., and Keller, A. G. Industry and Trade. Ginn and Company, Boston, 1923.

Chapter XXXII explains briefly the place of the corporation in the producing and distributing of goods.

Lamprey, L. Days of the Leaders. Frederick A. Stokes Company, New York, 1925.

An interesting book, easy to read. Chapter XXIII describes how Cyrus H. McCormick extended his business by a new device — the partial-payment plan.

*Lyon, Leverett S. Making a Living. The Macmillan Company, New York, 1926.

Chapter VII (How One Goes into Business), Chapter VIII (The Business Man's Task of Securing Money), and Chapter IX (Jobs in Finance).

*Wildman, Edman. Famous Leaders of Industry (2 vols.). L. C. Page & Company, Boston, 1920.

Short, interesting accounts of the way in which corporations were built by Philip D. Armour, George Eastman, Henry Ford, Cyrus H. McCormick, John D. Rockefeller, John Wanamaker, F. W. Woolworth, Andrew Carnegie, and others.

CHAPTER XXVII

THE UNITED STATES TRADES WITH THE WORLD

In the successive chapters of this book we have discovered one thing after another that helps to make possible our high standard of living: first, our favorable climate; next, our huge territory and rich natural resources; then, our scientific knowledge applied to the development of a vast system of machine manufacture and of transportation and communication; and, finally, many people ready to work.

But the list of the most important factors which have helped to make our new civilization is not yet complete. To round it out, one other factor must be included. We have learned how our modern civilization depends upon a great army of workers. We have already learned that we grow vast quantities of wheat and cotton; that we mine much iron and make much steel; and that great quantities of oil are taken from the earth each year. After the needs of the American people have been supplied, what do we do with the vast quantities that are left over? How do we get from other countries the things we do not have within the borders of our own country? The answer is, "Through trade with the other countries of the world." Billions of dollars' worth of manufactured goods, of foods, cotton, rubber, and other materials, enter and leave our ports each year. Thousands of ships of every description — cotton freighters, wheat freighters, oil tankers, steamships, sailing ships, oil-burning and coal-burning ships — are sailing the seas, tying the United States to the continents of the earth in a world-wide system of trade.

Trading with the peoples of other countries is not a new idea. Throughout every century of which we have any record, peoples traded with each other. Trade played an important part in the history of many countries. In China, in India, in Mesopotamia, and in Egypt the life of these ancient peoples revolved about the buying and selling of goods. In ancient times Crete became power-

ful because of its trade. The Phœnicians, another ancient people, were regarded throughout the known world in their time as great sea traders. The Roman Empire lasted long because of a system of trade that reached out from western Europe into Asia. For several thousand years the development of many countries and even of whole continents took place around trade.

FIG. 301. This picture compares the old *Ironsides*, which carried merchandise in the early 1800's, with the *Leviathan*, one of our largest merchant vessels of today. (Courtesy of the United States Shipping Board)

It was a desire for trade with the East that induced Columbus and the other explorers to search the seas for shorter trade routes. Columbus was not looking for a new world when he discovered America; he was in search of a short cut to the old Oriental world. When he reached the shores of America he hoped he had found the rich Spice Islands of the East. When Hendrik Hudson first sailed up the river past the island that is now New York, he thought he was on a waterway that would take him to the Orient. So it was through trade that the continents of North and South America were discovered, and it was through trade, also, that many of the early settlers came to America.

We repeat that it was the desire for trade that led the Europeans on their world-wide quest through the unknown oceans. The people of Europe in those days were eager for the spices of the East. It is hard for us today to realize how eager they were, for in our kitchens are ginger, cloves, cinnamon, and pepper, which

we have probably bought at a neighboring grocery. But in the 1400's and 1500's ordinary food was coarse, with but little variety, and spices made it taste much better. Consequently hardy seamen ventured out on the distant oceans because of the profit that would come from these much-desired spices, as well as from silks and other valuable products of the Orient. Spices were not the

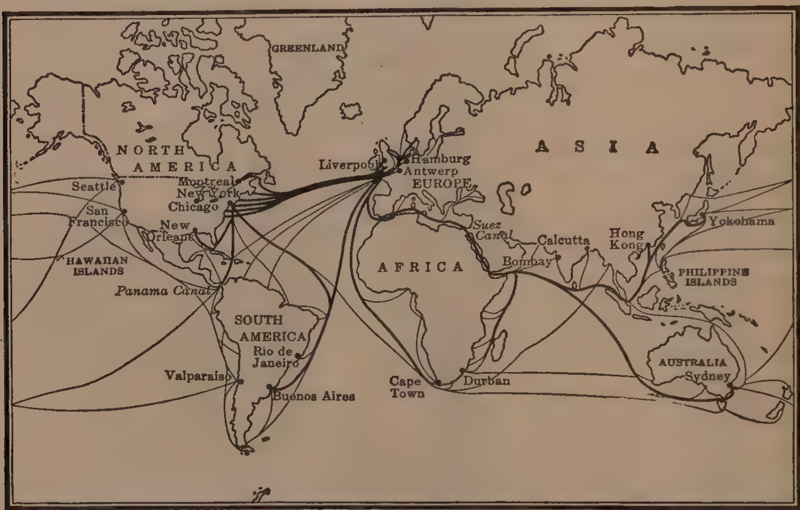

FIG. 302. This map shows that the United States trades with all parts of the world. Her tramp ships also enter many other ports not marked on the map[1]

only things which the Orient offered. Silks, ivory, ebony and other precious woods not found in Europe, were desired by the peoples of England, France, Spain, Portugal, Italy, and Holland.

Why did people desire these goods so much that they would pay fabulous prices for them? Because since the beginning of history man has craved fine workmanship, sparkling jewels, precious metals, and rich foods.

THE STORY OF COMMERCE IN EARLIER TIMES IS A STORY OF HIGH ADVENTURE

The adventures of the bold merchants of early times are as exciting as the exploits of soldiers and explorers. Too often we think of trade as a dull matter of dollars and cents, of bookkeeping,

[1] Isaiah Bowman, *The New World.* World Book Company, Yonkers, N. Y.

of selling goods over a counter. But these are just some of the means by which the great task of exchanging and distributing the world's goods is accomplished.

Let us pretend for a moment that we are back in the 1500's, watching one of the trading ships on its return trip from a successful journey to the East.

It is the year 1550. A square-rigged Dutch merchantman sails over the sea after a voyage of more than a year around the Cape of Good Hope to the far-off Spice Islands of the East Indies.

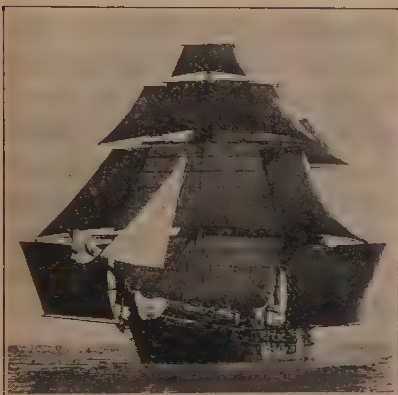

Fig. 303. The contrast between these two ships shows the difference between world trade yesterday and world trade today. The square-rigged sailing ship, with stanch hull of wood, could carry only a hundredth part of what the modern steel freighter conveys. The sailing ship had to reckon with the uncertainties of wind and weather, which the modern engine-driven ship can ignore

Suddenly from the direction of the Morocco coast a small speck appears on the horizon. From the crow's nest of the merchantman, away up on the masts, the watch shouts down an alarm. These are days of piracy and wars, and many of those who sail the high seas are enemies.

The captain shouts to his crew to spread more sail. They man the creaking windlasses and strain at the wheels, raising every yard of canvas on the boat. A tremor goes through the ship as the wind bellies out the unfurling sail. The ship leaps forward. But now follows one of those torturing races. The strange ship is gaining on them! Hours go by as the white spot on the horizon climbs higher, like a cloud, and then reveals a black hull. Nearer

and nearer it comes. The captain shouts to his men, and they roll the short, muzzle-loading cannon into position, standing by the powder fuse with lighted torches. The stranger is a pirate boat!

What follows may be one of those grim tragedies of the sea. If friendly darkness comes on before the pirate overhauls the merchantman, she may escape. If the wind is favorable, she may win the race; for in spite of their clumsy appearance these merchant ships are swift. Or she may, with a lucky broadside of chain shot, cut the masts and rigging of her pursuer, leaving it crippled. But if the pirate gunners outshoot the crew of the merchantman, the desperadoes from the pirate brig will swarm over her side with sabers drawn, and force the captain and crew to give up their ship with all its precious cargo, and possibly even to walk the plank.

Why is it that traders like these risked their lives on hostile seas? And why did pirates take desperate chances in attacking them? Because these boats carried goods more precious than gold, — rich silks from China, pepper and spices from the Celebes Islands, ivory from India, sandalwood and beautiful rugs from Persia, — such a store of goods as would make a monarch rich and equal the fortunes of ten ordinary merchants. The risks which these seamen took were great, but the rewards too were great.

The Story of Commerce today is very Different from that of Pirate Days

What a difference between modern commerce and that of the 1500's! People still crave gold and jewels, fine fabrics and ancient works of art — luxuries even today for most people. These things are still carried back and forth between countries, bought and sold by traders.

But these luxuries comprise only a small fraction of the freight carried in modern commerce. Commerce itself has greatly increased and at the same time greatly changed. In place of the small number of sailing ships that plied the seas 300 years ago, there are thousands of steamships swiftly moving from one port to another. And in place of spices, silks, and precious metals, the holds of these ships contain far more commonplace things — coal, oil, and other kinds of fuel; wheat, corn, rice, potatoes, prepared

meats, and other kinds of food; cotton and woolen yarn and cloth, suits, shoes, hats, garments of every description; iron ore and manufactured steel goods; automobiles, agricultural machines, tools, implements, hardware of many kinds. It is fuel, raw materials, and manufactured goods that today make up the bulk of world trade. World trade formerly consisted mostly of luxuries, but today much of it consists of necessities.

In such ways as these has the Industrial Revolution changed not only ways of living in one country but also the interchange of goods between countries.

In this enormous movement of freight from country to country the United States plays an important part. In a recent year the Department of Commerce reported that there were nearly 5000 ocean vessels on the seas owned either by the United States government or by private American companies. Today American steamers sail from New York, Boston, Baltimore, and Philadelphia, loaded down with wheat and other foodstuffs. They carry machinery and other kinds of manufactured goods for England, for most of the other European countries, and for many parts of Asia, Africa, and South America. From the port of New Orleans and other Southern seaports they carry to England and other countries each year tremendous quantities of cotton. American ships carry beef and mutton and a great variety of foods to countries depending upon us for such things. Low-lying oil tankers, looking like monsters of the deep, carry crude oil to distant cities.

International commerce is of two kinds: *exports* and *imports*. *Exports* are the goods sent out of a country; *imports* are the goods brought into a country. In the modern world most countries export those products of which they have more than their own people need, and import those products of which they have too small a supply.

We can sum up the situation by saying that the United States is both an *exporting* nation and an *importing* nation. We buy many things from other countries. In a very recent year we sold more than we bought. Our total exports and imports were as follows:

Exports	$4,876,615,000
Imports	4,146,000,000
Excess of exports over imports	$730,615,000

The United States has always been a Trading Nation

This world trade in which our country engages today is not a new development. From the beginnings of the settlement of North America our people have traded with other people. The New England colonists had no sooner established their little communities along the coast than many of them turned to the sea to earn a livelihood, not only by fishing but also by trading with other

Fig. 304. The skeleton framework of a wooden ship, like hundreds of sailing ships made in colonial days near New England harbors. Such craft are still made, but are little used for ocean transportation. Steel ships, propelled by oil or coal, have largely replaced them for ocean trade. (Photograph from Keystone View Co.)

people. Handmade wooden ships were built in many small New England shipyards, and sailed forth from every sheltered harbor. You have already read in Chapter XXII how the people in Providence began very early to build ships for fishing and trade. It was the day of sailing ships, and almost every man and boy knew how to handle the sheets, to make the most of wind and tide, and to master the dangers of a storm-swept sea.

These colonial shipmasters did more than merely trade with other ports up and down the coast. They took their ships also to Europe, into the Mediterranean Sea, around Africa to India and China, around Cape Horn to the western ports of South and North

America, and to the Far East. To endure these long voyages ships had to be made strong and seaworthy. American shipbuilders soon achieved a world-wide reputation for the speed as well as for the strength of their vessels.

Gradually, throughout the late 1700's and well into the 1800's, the merchantmen of the United States developed a large trade with the distant ports of the world. Some of the ships sailing from Boston would sail around Cape Horn to San Francisco on the Pacific coast to barter with the Indians for furs. Loaded with furs they would cross the Pacific and trade them with the Chinese for silks, teas, and other things. When unable to secure the furs, they would pack the hold with ice for ballast and take this to the Chinese port of Hongkong, where it was much appreciated in the hot summers. (Even today in Hongkong "Ice House Street" is a reminder of this early American ice trade.)

© Ewing Galloway

FIG. 305. A clipper

In the meantime, throughout the early 1800's, American commerce with Europe was growing rapidly. Lines of packet ships sailed on regular schedule, carrying passengers and mail and freight as do our ocean liners today. These packet boats were under sail instead of steam power and were rarely able to make the trip between New York and English ports in less than 20 days. There was much rivalry between the ships of various countries, and races were frequent. One of these ships, the packet *Columbus*, made a voyage in sixteen days, which, for a sailing vessel, was a splendid record. (Our swiftest modern liners, however, make the trip regularly in about six days.)

So until about the middle of the 1800's the United States steadily increased its "merchant marine," as its trading ships were called. In fact, the fame of these ships spread around the

world. Figure 305 shows one of the American "clippers"; these ships were the most beautiful vessels afloat. No other nation could boast their equal in speed and endurance. The men who sailed them were equally famous. They came from families on our Eastern coast whose boys had always turned to the sea to make a livelihood. They were known as seamen born and bred.

After 1860 the American Merchant Marine Declined

By 1860, however, a new day was clearly dawning for American ocean commerce. Steam power was beginning to replace sail power, steamships were taking the place of sailing ships. Recall that in the years following 1825 both the English and the American people were beginning to take up manufacturing. Steam power was being applied to boats as well as to locomotives. You will remember that as early as 1807 Robert Fulton had succeeded in making a practicable river steamboat, and only twelve years later the *Savannah*, an American steamboat, made the first successful crossing of the Atlantic Ocean. After this, shipping companies slowly began to equip their vessels with steam engines. As the years went on, more and more steamboats appeared in ocean commerce and gradually took the place of the swift-sailing packets. Fast as the packets were, they were dependent upon wind and tide; hence their schedules of sailing were somewhat uncertain. The steamship was not only more rapid but, depending little upon the weather, it could maintain a fairly regular schedule between the continents.

So the steamship replaced the sailing ship. But even so the total number of American ships on the seas steadily declined. Why did this happen after 200 years of sea trade? Four reasons accounted for the decline from 1860 to 1910, as shown in the left half of figure 306: *first*, the Civil War, 1861–1865; *second*, the increasing demand for ocean-going vessels made out of iron and steel instead of wood; *third*, the increasing interest of the American people in the Westward development of their country, and the decline of interest in the sea; *fourth*, the gradually increasing cost of labor and materials in the United States, which made it impossible for American merchants to build and run their

ships as cheaply as foreign merchants could build and run theirs. Let us consider these four factors somewhat more fully.

1. For four years the trading life of the United States was seriously changed by the war between the Northern and the Southern states. Both the man power and the money of the two sections of the country were needed for the war. Naturally, therefore, during the years 1861–1865 the building of merchant ships in the United States declined. Merchant ships were used as battleships by the North and the South. Some of them were destroyed, and this still further weakened our merchant marine.

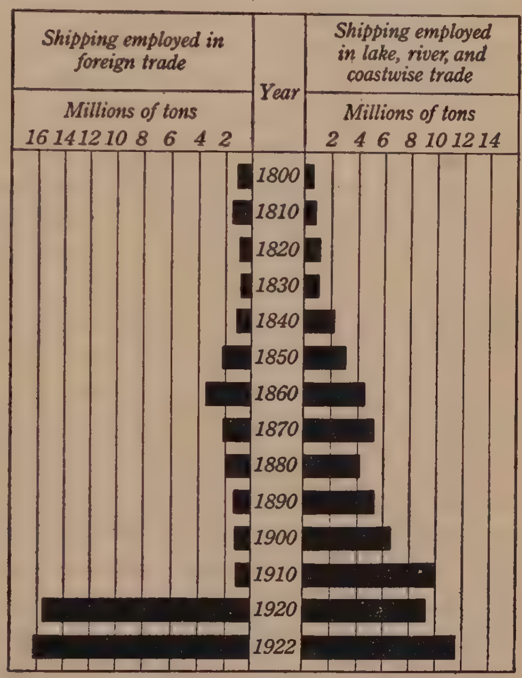

FIG. 306. The bars show for each year the amount of freight carried in vessels flying the American flag. The bars on the left show the freight transported between the United States and other countries; those on the right the freight transported within our own country. Note the decline in American vessels engaged in foreign trade between 1860 and 1910 and the sudden increase between 1910 and 1920. This increase was caused by the World War, 1914–1918

2. As steam vessels became more powerful and began to replace wooden sailing ships, England made greater strides than ever in shipbuilding. Prior to the use of iron and steel, American shipbuilders had a decided advantage over their English competitors in the abundant forests of the United States, which supplied the fine lumber for their sailing vessels. But until the later 1800's England was producing much more iron and steel than the United States. English shipbuilders, therefore, had plenty of iron and steel from which they could construct ships.

3. There was another reason for the decline in the American merchant marine at this time. That was the great interest of all classes of Americans in the settlement of Western land and in the development of manufacturing and business. With the close of the Civil War more people than ever before went into the Western frontier country. It was the period of the building of the first continental railroads and of the development of farming west of the Mississippi. There was a great lure in the free land of the West. Sailors and civilians alike turned more and more to the land instead of to the sea for a livelihood. These facts greatly diminished our interest in foreign shipping. The graph of figure 306, however, shows that there has been a rather steady increase in our shipping engaged in lake, river, and coastwise trade.

Per Cent of Foreign Commerce carried in American Ships	
In 1857	71
In 1860	67
In 1870	36
In 1880	18
In 1890	12
In 1914	10
In 1924	36

Furthermore, business men were beginning to make more money by investing in factories, in coal and iron mines, in oil companies, in railroads, and in construction companies than they could by investing in ships. Hence both the lack of men to build the ships and to man them and the lack of money to construct and operate them caused the American merchant marine to decline.

4. There was still another reason. This was the greater expense of building and manning ships in the United States than in England. Furthermore, there was an American law that would not allow any vessel that was not built in this country to register in the United States and to fly the American flag. This, of course, gave English shipbuilders an advantage. The cost of labor and materials had by this time increased in the United States to such an extent that American shipbuilders could not compete with those in England. By 1906, for example, American seamens' and builders' wages were almost twice as high as such wages were in England. American merchants were not able to purchase their ships abroad and sail them under the American flag.

This was the condition of affairs from 1865 until 1914. The United States was trading in vast amounts with other countries,

but most of the exported goods as well as the imported goods were carried in ships that flew foreign flags.

Then came the World War, and with it a great need for ships. American shipbuilding expanded tremendously within a few years. Note how clearly the growth in American ships is revealed in the left half of figure 306. In 1910 we had not much more than 1,000,000 tons of shipping under our own flag; in 1920, nearly 16,000,000 tons.

At the beginning of the war, in 1914, less than 10 per cent of the foreign commerce of the United States was carried in American ships. At that time there were only 42 shipyards in the United States equipped to construct steel vessels. At the close of the war there were 341 such shipyards.

Vessels clearing from United States Ports	1914	1924
American-owned . .	953	4833
Foreign-owned . . .	8877	7681

With the coming of the war, much of England's great merchant marine was pressed into naval service or into the transportation of supplies, raw materials, men, and food needed by England and her allies. The cry was for ships! More ships! Almost at once shipyards in the United States became very busy. New ones were started, and when our country entered the war the government opened many more.

The comparison given in the table on this page sums up the influence of the World War upon American shipping.

As a result of the recent growth in the shipbuilding industry American shipowners today have approximately 5000 vessels engaged in foreign commerce. Most of these are engine-driven and attain speeds undreamed of in early days. Furthermore, most of them are equipped for the shipment of special kinds of goods. There are freight steamers equipped with refrigerators for the transporting of perishable goods. There are specially built coal steamers, oil tankers, wheat ships, and vessels for the transporting of other food products. There are concerns that have whole lines of ships constructed for the special shipment of fruit. But the American merchant still faces many problems.

For 100 Years the Foreign Trade of the United States has Grown

In spite of the decline in shipbuilding until 1914, our export trade did not suffer, owing to the fact that we shipped in boats owned by foreign builders.

In the last century and a quarter the foreign trade of America has steadily grown. In 1800 we exported $70,000,000 worth of goods; in 1870, $393,000,000 worth; and in 1910, shortly before the World War, about $1,750,000,000 worth. Then, with the coming of the war, European countries, engaged in a struggle for their lives, purchased great quantities of food, of raw materials, and of manufactured goods from America, amounting in 1916 to $4,000,000,000, and in 1920 to about $8,000,000,000! After that date the people of Europe turned again to the raising of food, to manufacturing, mining, and all the other peace-time kinds of work, and bought smaller quantities from us. Nevertheless, as recently as 1927 the outside world purchased from us nearly $5,000,000,000 worth of exports.

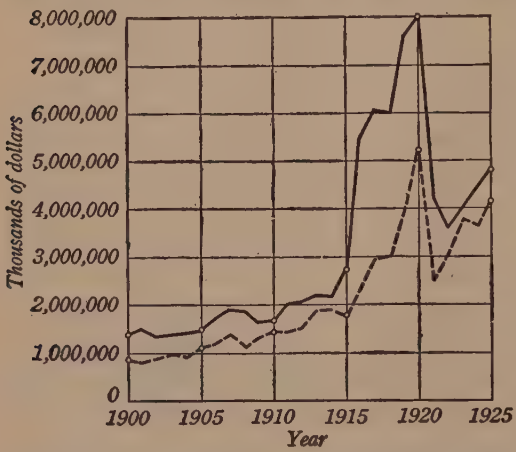

Fig. 307. Exports and imports, 1900–1925. The solid line represents our exports; the broken line. our imports

In the meantime we were also purchasing goods from abroad; that is, we were importing as well as exporting. Note how imports increased: in 1870 we imported goods valued at $500,000,000; by 1910 the total had risen to $1,500,000,000; and by 1927 it had attained the enormous amount of $4,000,000,000.

These figures illustrate an important fact concerning the way in which the modern nations live. Formerly they traded with each other largely for luxuries. Today every modern country trades

FIG. 308. We trade with all the world, but principally with the countries that are shaded. From 1923 to 1926 our imports and exports with five countries averaged more than $200,000,000; with eight others it averaged more than $100,000,000

with many other countries for the very necessities of life. Each country specializes in the production of certain goods. Some produce more wheat, more corn, rice, potatoes, or other foods than their own people need, and sell the surplus to other countries. Some of them have more coal than they need, and they sell this to other countries in exchange for cotton, which they cannot raise, and for wheat or other foods of which they do not have enough. Some nations, like Sweden, Spain, or France, have great iron mines, and export their surplus of that material in return for coal or manufactured goods or various kinds of food.

More than three fifths of all the cotton grown in the world is raised in the United States, but only one third of that is manufactured here into yarn and cloth. We have 40,000,000 acres of land planted each year to cotton. But although our textile manufactures have increased greatly, our factories are unable to use two thirds of this product. Why, then, do the cotton planters of the South raise so much cotton? To sell to the cotton manufacturers of other countries.

Germany and the United Kingdom receive the larger part of this exported cotton. France, Spain, Italy, and several other European countries receive smaller amounts. Cotton has been the chief export of the United States throughout a very long period of years. At the present time it comprises about one fifth of all the raw materials, foods, and manufactured goods which we sell to other countries.

That our farmers depend upon other countries for their living is shown by another example of exports. One sixth of all the food products raised in the United States is sold outside our own country. Each year American farmers produce more of certain kinds of food than the American people consume — wheat, corn, rye, and meat, for example. Since the beginning of the World War our exports of these foods have greatly increased; the amount of wheat has doubled, the amount of barley trebled, and the amount of rye multiplied many times.

Until the past few years the principal trade of the United States has been with the United Kingdom. In 1925 one fifth of our total exports was sold to the United Kingdom, while from it we received one tenth of all our imports. The chief exports consisted

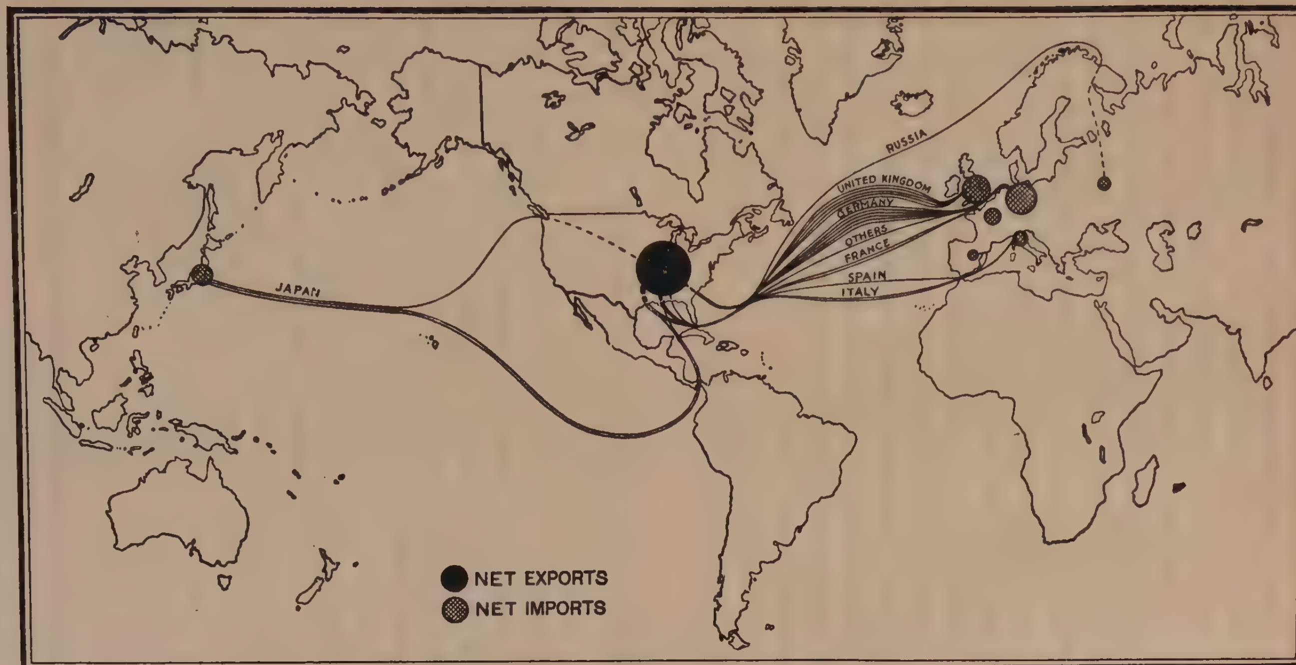

Fig. 309. The relative sizes of the shaded circles in this map show what proportions of the exportation of cotton from the United States (shown by solid black circle) are imported by other countries

of cotton, grain, beef and pork, gasoline, tobacco, lard, and automobiles. From the United Kingdom we imported woolen and cotton cloth, tin, and crude rubber which had been obtained from the British rubber plantations in the Far East.

Recently trade with our neighbor Canada has exceeded that with England. In 1927 we shipped more goods to Canada than to any other country. After Canada and England our largest exports are to Germany (cotton and lard), Japan, and France (grain, cotton, gasoline, and copper).

Our exports to other countries have changed not only in amount but also in kind. Two thirds of our exports 30 years ago were agricultural — grain, meat, cotton, tobacco. Since that time the United States has become one of the world's greatest manufacturers. Hence our exports have come to consist more and more of manufactured goods. Today the United States is second only to Great Britain in this respect, and its factories supply nearly half of all the manufactured articles used in the world.

How our Foreign Trade compares with Trade within our Country

The facts are now before us from which we can see clearly that the United States has become a great trading nation. In the last two chapters we saw many examples of this. In this chapter we have seen the recent growth of our trade with other countries. How does the foreign compare with the domestic (internal) trade?

VALUE OF DOMESTIC AND FOREIGN TRADE OF THE UNITED STATES, 1890–1924

Year	Domestic Trade	Foreign Trade
1890	$8,400,000,000	$1,300,000,000
1900	11,900,000,000	2,200,000,000
1910	28,900,000,000	2,800,000,000
1924	48,200,000,000	7,000,000,000

The figures in the foregoing table tell an astonishing story of the increase in trade in the past 40 years. In that time the amount of buying and selling of goods done by the American people has

doubled and doubled again. The trading done today is valued at six times the trading of 1890! Of course, most of this trading is done by Americans with each other. A tremendous volume of goods, foodstuffs, and raw materials must be exchanged in order to feed and clothe our people, to provide homes for them, to transport them and their goods about the country, to enable them to communicate with each other, and to provide them with recreation. From your previous studies you can easily imagine the number of stores and the amount of labor necessary to supply these things for 115,000,000 people. After food, clothing, shelter, and a certain number of luxuries are provided for our own people, the rest of our products can be exported. It is to be expected, therefore, that our domestic trade will be larger than our trade with foreign countries. The table shows that throughout the past 40 years it has been many times larger.

How the United States Department of Commerce helps our Business Men in their Foreign Trade

In recent years the Department of Commerce at Washington has established a bureau to help American shippers with their foreign trade. One of the most important services rendered by this bureau is the collecting and sending out of information concerning trading conditions all over the world. It is very difficult for farmers, manufacturers, and merchants to know exactly where to find the best markets for their goods. It is only the wealthy corporations that can afford to send salesmen to the many countries with which we trade. To help the thousands of other business men the foreign-trade bureau conducts its valuable information service. In a recent year this bureau received, on the average, 7000 inquiries a day from manufacturers, farmers, and shippers all over the United States. These queries were carefully studied and answered. The bureau has representatives abroad in many countries, who are reporting constantly the condition of markets in their districts.

The following example shows how this service helps trade and how it finds new markets. In a recent year the Rice-Growers' Association of California had on hand 4,000,000 bags of rice and no

purchaser for them. The Department of Commerce found a buyer where least expected — in Japan, a country that itself produces a large amount of rice.

Not only does the bureau find markets for surplus products, but it also informs business men of the places where there is no market for their product. For example, it says, "Don't try to sell automobiles in Bermuda; the use of motor cars there is prohibited by law!"

Other useful advice is given by this bureau. A bulletin, "Packaging for Foreign Markets," shows by actual illustrations how goods should be prepared for shipment to various regions. Many American firms have needed such advice, as is shown by the following example. An American candy firm sent chocolates in cardboard boxes to Canton, China. The Chinese do not raise chocolate themselves, but are developing a great liking for it. The candy sent by the American firm was spoiled because the shippers did not know about the hot, damp climate, and so did not pack it in air-tight tins. As a result the Chinese merchants in that vicinity bought their chocolate candy from shippers in Great Britain, who pack theirs in tin cans.

Another American company sent to a South American country a shipment of farm machinery. When it arrived it was found to have been shipped with its parts wrapped separately, and there was no salesman or mechanic on hand to show the buyers how to assemble it. This resulted in a loss of trade for that company.

From such examples as these you can begin to understand what an important service can be rendered by an information bureau like that in the Department of Commerce.

Looking back over our Study of World Trade

By illustrations such as we have been studying in this chapter we see how our country has become one of the world's chief traders. Throughout our entire history, from colonial days to the middle of the nineteenth century, we were shipbuilders, skillful seamen, and shrewd business men. Until about 1860 both our merchant marine and our trade with other countries grew steadily. Then, with the Civil War, came important changes. Steamships

replaced sailing ships. Vessels made of iron and steel replaced wooden ships, and our own merchant marine declined in size and in value. Great Britain could build steel steamships more cheaply than we could, and, until the beginning of the World War, Great Britain was the unquestioned mistress of the seas. Our own people, however, were developing unexpected amounts of wealth in our Western lands in farms, mines, and railroads. Hence, although our merchant marine declined, our world trade increased.

With the coming of the World War came other great changes. *First*, we again built up a large merchant marine. Because of the great need for ocean vessels shipbuilding started up again in the United States. Within a few years thousands of ships were constructed and put into service under the American flag. As a result our foreign trade in food, raw materials, and manufactured goods grew at unexpected rates. Today the United States has become one of the world's greatest trading countries.

Second, the increase in our national wealth brought about another significant change. The increase in the number of persons of considerable wealth led to a very great increase in the investment of American money in other countries. Up to 1900 our country was comparatively a new and undeveloped land, and such wealth as it had was invested mostly within our own boundaries. After that time, however, more and more Americans turned to other new countries to invest their surplus wealth. The result has been that in recent years billions of dollars of American capital have been invested in Canada and in Mexico and other Latin-American countries. Today three fourths of our foreign investments are in those places and only one fourth in the other continents.

INTERESTING READINGS FROM WHICH YOU CAN GET ADDITIONAL INFORMATION

Books

ABBOT, WILLIS J. The Story of the American Merchant Marine. Dodd, Mead & Company, New York, 1919.

CARTWRIGHT, CHARLES E. The Tale of Our Merchant Ships. E. P. Dutton & Company, New York, 1924.
A good book describing sailing ships.

DANA, RICHARD HENRY. Two Years before the Mast. The Macmillan Company, New York, 1924.

A true story of a trip in a sailing vessel from Boston around Cape Horn and up the Pacific coast in the 1830's.

FRENCH, JOSEPH LEWIS. Sagas of the Seas by American Writers. The Dial Press, New York, 1924.

Excellent fiction stories regarding shipping and whaling between 1620 and 1850.

*HOLLAND, RUPERT S. Historic Ships. Macrae Smith Company, Philadelphia, 1926.

An excellent book, easily read.

*HUNTINGTON, ELLSWORTH, and CUSHING, SUMNER W. Modern Business Geography. World Book Company, Yonkers, New York, 1925.

Chapter XXII (The United States as a Market).

*KEIR, MALCOLM. The March of Commerce (Volume IV of The Pageant of America). Yale University Press, New Haven, 1927.

Chapter I (The Commerce of the Colonies), Chapter II (The Old Merchant Marine), and Chapter VIII (Ocean and Lake Commerce in a Mechanical Age).

LEEMING, JOSEPH. Ships and Cargoes: the Romance of Ocean Commerce. Doubleday, Doran & Company, New York, 1926.

Describes the evolution of ships.

MEIGS, CORNELIA. Clearing Weather. Little, Brown & Company, Boston, 1928.

An interesting novel of shipping during the latter part of the eighteenth and the early part of the nineteenth century.

ROGERS, STANLEY. Ships and Sailors. Little, Brown & Company, Boston, 1928.

Exciting stories of shipping during the 1700's and 1800's. Easy to read and well illustrated.

*WILLIAMS, ARCHIBALD. The Romance of Modern Engineering. J. B. Lippincott Company, Philadelphia, 1921.

This book describes the complicated machinery that drives our large ocean liners.

WHITBECK, R. H., and FINCH, V. C. Economic Geography. McGraw-Hill Book Company, New York, 1924.

For the best readers. Chapter XVI (Foreign Trade and Transportation).

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*"The Geography of our Foreign Trade," *National Geographic Magazine*, January, 1922, pp. 89–108.

*"Ships for the Seven Seas — the Story of America's Maritime Needs, her Capabilities, and her Achievements," *National Geographic Magazine*, September, 1918, pp. 165–199.

An illustrated story of the building of our marine.

UNIT IX

INTERDEPENDENCE IN THE MODERN WORLD

CHAPTER XXVIII

HOW AMERICANS DEPEND UPON ONE ANOTHER

A man lives in a house made of lumber from Oregon or brick from Kingston, New York, and heated by coal from Pennsylvania. From a bed made in Jersey City he is roused by an alarm clock made in New Haven. He bathes in a tub from Perth Amboy with soap from Cincinnati. He puts on garments of Georgia cotton, and shoes from St. Louis, made from leather tanned in Newark, of a steer raised in Texas and killed in Chicago. His suit is of Wyoming wool, spun in New England and tailored in Rochester, while his hat is from Danbury, Connecticut. He sits down at a table made in Grand Rapids, Michigan, on chairs from Gardner, Massachusetts. On the table is china from Trenton, and silverware made in Providence from Nevada silver. He eats honeydew melon from California, Virginia ham, and New York eggs, with rolls made from Dakota wheat ground in Minneapolis, and spread with butter from Wisconsin. Upon leaving, he lights a cigarette from Winston-Salem as he reads a paper made from Maine spruce, walking meanwhile over sidewalks of Allentown cement.

You know from your studies in this book that in the days of our forefathers a family living on a farm might almost live to itself, for it did its own spinning and weaving, made its own shoes and furniture, ground its own grain, and raised its own cattle.

Today all that is changed. A family living on a farm depends upon other people for its clothing, its furniture, its household implements, even for much of its food. Instead of being self-sufficient, the farm family depends upon the city for manufactured goods, prepared foods, and machines. Similarly, the people in the city depend upon the farmer for their food and upon other city people for many of their manufactured goods.

"You do this and I'll do that, and we'll exchange," is the motto of today. Men grow things or make things and sell them for money, with which they can buy other things. It is truly the day of *interdependence*. Let us consider some examples.

1. How One Section of the Country depends upon Another

We have learned that the United States extends over a vast area, and that its climate, the lay of its land, and its resources are so varied that it is said to comprise several "sections." We found, furthermore, that although the sections are tied together by means of swift transportation and communication, the kinds of work people do in them vary greatly. In New England, for example, agriculture is confined to special products, such as fruit, potatoes, hay, and garden truck. Throughout the states of our central plains agriculture specializes in the raising of wheat and corn, although small quantities of other products are also raised. In the southern section of the United States agriculture consists largely in the raising of cotton and, in small special areas, in the growing of citrus fruits. On the high plateau lands of the West, on the other hand, agriculture is confined to the raising of cattle. Similarly, near the Canadian border there is a special spring-wheat region, on the northwestern coast a fine fruit-raising section, and in California another specialized citrus-fruit region.

Thus we see that in agriculture each section of the country, having its own special conditions of temperature, rainfall, and fertility of soil, tends to specialize in certain products. Each section, therefore, depends upon other sections for their special agricultural products.

So it is with the manufacturing of goods. We have learned that a vast proportion of the manufacturing of our country is done in the states north of the Ohio River and east of the Mississippi. Hence the other sections of the country depend upon this industrial section for a large part of their manufactured goods. It is important to remember that manufacturing has also sprung up in many small centers outside this section. There is, for example, much manufacturing of cotton yarn and cloth in the Southeastern states, where formerly nearly everybody engaged in the raising of cotton. There is, likewise, much manufacturing in a few large cities scattered about the country, such as Kansas City, Seattle, Portland, San Francisco, and others. Nevertheless, most of the people of the country depend upon the cities and towns of the chief industrial section for their manufactured goods.

This same dependence of one section upon another is illustrated also in the case of basic fuels. For most of our oil we depend upon a few small areas, such as the Los Angeles and Southern California field, the Oklahoma-Texas-Kansas field, and the Gulf coast field. Similarly, for our best anthracite we depend upon the small region in Pennsylvania. For most of our bituminous coal we rely upon the section comprising Pennsylvania, Ohio, Indiana, and Illinois. Although coal is also found near other manufacturing centers, as in Alabama, in general the United States depends upon one section for coal; namely, the section from Pennsylvania to Illinois.

Interdependence between sections is illustrated in the case of other important natural resources. Most of our iron, for example, comes from Minnesota, most of our copper from Montana, and most of our zinc and lead from Idaho and Missouri.

These facts show clearly that the sections of the United States depend upon one another. No section can live only on its own resources in our modern civilization. We have become accustomed to such a high standard of living, we insist upon such a wide variety of food and of materials for clothing and shelter, we demand such a great range of comforts and luxuries, that no section of the country can supply its own needs and feel entirely independent.

2. How the Farmer depends upon the City Dweller and the City Dweller upon the Farmer

This important fact of *interdependence* is illustrated likewise in the complete dependence of farmers upon city dwellers and of city dwellers upon farmers.

Your grandparents will remember the time when the local butcher raised his own cattle and fattened his own hogs, slaughtered them himself, and then peddled the meat from door to door. Generally, too, he made sausages, smoked hams and bacon, "tried out" the fat of the pork for lard, and corned his beef. In those days most farmers raised much of their own meat and bought only a small portion from the local butcher.

But now specialization of work has changed even the slaughtering and preparing of meat. Instead of each of thousands of rural

communities having its own slaughterhouse, the cattle, sheep, pigs, and even chickens from the rural districts are sent to the cities for slaughter. The farmer then buys back his product as meat. Even on farms where hogs are raised, the bacon which the farmer eats usually comes from the big Chicago packing houses. Many wheat farmers buy all their bread. Their wheat is sold to the mill, where it is ground into flour. It is bought by the big bakeries, which sell it back to the farmer, through his small country store, as wheat bread. So the farmer, as well as the city dweller, depends upon workers in cities for much of his food.

Of course many farmers *could* live on food which might be raised on their farms, but for most things today they are absolutely dependent upon the factories and stores of the cities. Recently a conversation was overheard between a farmer and a city boy who was visiting a rural district. The boy was surprised to find that the farmer bought most of his necessities from places many miles distant. He remarked upon this to the farmer, who replied:

"A great change has come in the way we live, Fred, in the time since I was a boy. It's only a short run out from Kansas City with these fast trucks. They do it in twenty minutes now. I used to take all day to jog in behind our old mare. We've come to depend on city things, and now we feel we can't get along without them. The expressman came only an hour ago with an order of groceries and hardware from a big store in Chicago. There comes a truck up the road now with some things that Mrs. Hutchins ordered over the telephone this morning."

Another episode illustrates how the farmer depends upon the city for farm machinery and tools.

"Well," said John Jones, a farmer in Kansas, as he came into the kitchen to wash before dinner, "I'll have to get a new plow."

His wife took the lid off the frying pan and turned a piece of chicken she was frying.

"You've been threatening to long enough," she answered.

"There comes a time," said her husband, "when it doesn't pay to use an old plow any longer. I'll go into town tomorrow and order a new one."

"Where'll you get it, uncle?" asked Jim, his young nephew from the city.

"I'll order it from Sam Jarvis's store."

"Where'll he get it?"

"Well, I reckon he'll have to order it from Chicago."

Many illustrations could be given of the ways in which country people depend upon city people, but they are not needed here.

What about the dependence of the city upon the country? We have learned that half of our people live in cities, and that almost all of them are engaged in occupations other than the raising of food. It should be clear without further illustrations, therefore, that the more than 50,000,000 people who live in our towns and cities depend absolutely upon the farmers of the rural districts for their food. Although bread and cereals are prepared in large factories in cities, although many kinds of food are preserved and canned in urban districts, nevertheless for grain and other foodstuffs we depend upon the country.

3. How One Industry depends upon Another

Not only does one section depend upon other sections, not only do the city and the country depend upon each other, but one industry also depends upon other industries.

Consider, for example, the extent to which all manufacturing depends upon the coal industry. We learned in earlier chapters that although an increasing number of factories are using hydroelectric power, and although many have recently introduced oil-burning engines to drive their machines, nevertheless most of our manufacturing plants burn coal under their boilers. Any interruption in the mining and transportation of coal, therefore, seriously affects many industries in different parts of the country. If the miners in the coal districts go on strike for a long time, the nation's coal pile rapidly dwindles. Soon factories in the industrial centers shut down because of lack of fuel. People are thrown out of work and, lacking money, are unable to purchase more than the bare necessities of life. This reduces the amount of buying and selling of goods, thereby affecting owners and workers not only in many industries but in stores and offices as well. A prolonged interruption to the mining of coal, therefore, would seriously affect almost all occupations of the country.

FIG. 310. Think of all the industries that are dependent on this coal. Coal means fuel; fuel means power; power means machines in motion; machines mean a supply of the many things that make possible our standard of living

All the manufacturing industries depend not only on coal but on steel as well. If the supply of steel is interrupted for one reason or another, the work of people in many occupations is endangered.

Two men were talking over conditions in the building industry.

"So steel's gone up again," said one.

"Yes," replied the other, "I'm putting up a fourteen-story building down town, and I'm feeling the high price of steel. If the price of building materials keeps going up, we won't be able to do any building."

"That's right," said the first man, "I decided yesterday not to do any more building for a while because I knew it wouldn't pay me."

How will the rise in the price of steel affect this man's employees?

As you know, machinery is made of steel. In our new civilization, as you have learned, almost all manufacturing is carried on by machinery.

"Aren't you working, John?" inquired Peter Russell of his neighbor, John Whitcomb, as they met at the corner of the street on which they lived.

"No, they can't get yarn from Nockege Mills. So we warpers, spinners, and weavers are all out at Mill C. Makes me wish I was working where my bread and butter didn't depend on someone else."

"What's the matter this time?" asked his neighbor sympathetically.

"Oh, the yarn-mill people claim they can't deliver our yarn because their machinists have been on a strike and many of their machines are out of repair. The yarn workers are laid off, too. Ten days' loss of pay in the past two months pinches my pocketbook a good deal."

Consider also illustrations of the dependence of all manufacturing industries upon those which make machines. Take the publishing of newspapers, magazines, and books. This depends upon machines — typesetting machines, printing presses, binding and stamping machines. Publishing would be interrupted and might later stop altogether if the industries which make these machines should cease.

Flour, bread, breakfast foods, canned goods, and other important foods are prepared by machines and sold to us in the neighborhood grocery. Where would our local tradesmen get their supplies of ready-to-serve foods if the industries that make machines used in flour mills, in bread-making, in cereal and canning factories should shut down? Automobiles, locomotives, cars, telephones, telegraph instruments, and wireless instruments are made by machines. The workers in all these industries depend, therefore, upon other industries which make these machines. If our machines break down, it is bad enough. If the machines which make our machines break down, it is even worse.

The manufacture of telephones further illustrates how one industry depends upon a great many others. There is, for example, the manufacturing of a certain kind of paper tape, in which telephone wire is wrapped. A recent estimate by the manufacturers states that 9000 miles of paper tape is made each day. Furthermore, the wrapped telephone wires or cables depend upon continuous supplies of lead pipe, in which cables are tightly sealed. The manufacture of telephones also depends upon the mining of

platinum, a mineral more valuable than gold, required in the making of telephone transmitters. So it is with the manufacture of other telephone parts. Each step depends upon one or more other industries, such as the manufacture of hard rubber, of brass rods, of copper wire, and of many other things.

Do not these illustrations make perfectly clear the interdependence of industries?

4. How One Worker depends upon Another

Not only does one industry depend upon other industries but occupations within any one factory depend upon other occupations carried on in the same factory. Division of labor has been carried so far in the making of cloth, shoes, or garments that each department in any one factory depends upon the continued operation of other departments.

Fig. 311. If the workers in the yarn mills struck, this young woman would be out of work, too

Think, for example, of the many steps involved in the manufacturing of cloth. When you go to a store to buy cotton cloth, do you ever think how many hands the cotton has passed through before it reaches you? Five different handlings are required to get the cotton to the mill: it must be picked, ginned to remove the seeds, packed into bales, compressed, and shipped. When it reaches the mill, the bales must be opened, the cotton must be cleaned, the fibers must be straightened, lengthened, and twisted on bobbins, and again twisted and wound on spindles. The thread is then bleached or dyed and woven into cloth, and the surface of the cloth must be finished. Thus in the manufacturing of yarn and cloth there are thirteen processes. Thus many steps must be taken to turn raw

cotton into cloth. Four more are required to bring the cloth to the counter and to sell it to you. What would happen in this chain of links if one should break? All the workers in departments that make use of processes which come later in the series than the one that broke would be thrown out of work.

Another example: shoemakers depend upon carpenters. In a shoe factory which had been so organized that it could turn out 2400 pairs of completed shoes each day, it was noted that the company's output began to fall off. For several weeks it ran as low as 1900 pairs a day. What was the cause of this daily loss of 500 pairs? Lack of carpenters! In a certain department the smooth running of the work depended upon a supply of wooden racks. When the carpenters were not on hand the supply of racks diminished and the shoemakers were slowed down in their work.

At one of the great Brooklyn shoe factories things went wrong one morning. A new workman broke an important part in a complicated contrivance, tying up a group of related machines.

A few minutes after the telephone rang in the office of the United Shoe Machinery Company's service department on Warren Street, New York. On receiving the message the service manager touched two buttons on his desk.

In a large room on the same floor a dozen mechanics — out of a staff of 75 — were on reserve duty when the indicator on the wall recorded the summons for repair men Nos. 49 and 64. Immediately these two reached for their hats and reported at the desk. Within ten minutes they had gone to the stock room in the basement, secured the machine parts necessary, and were on their way to Brooklyn. Before the noon whistle blew the replacements in the shoe factory had been made and all the workers were going full speed.[1]

You have now read several examples of interdependence — of the dependence of sections upon other sections, of the dependence of some industries upon other industries, of some workers upon other workers. However, if we ceased to raise all our own agricultural products, we *might* be able to buy them from other countries. If we stopped manufacturing of all kinds, we *might* be able to buy sufficient manufactured goods from other countries. There are two industries, however, upon which every one of us depends.

[1] Courtesy of the United Shoe Machinery Company.

5. How All Industries and All People depend upon Transportation and Communication

Not only are industries and workers dependent upon one another, but all depend upon communication and transportation. Each industry must be able to buy the necessary raw materials and to sell its products. Hence there must be telephones, telegraphs, postal service, and other means of rapid communication. There must be railroads, auto trucks, steamships, and other means of transportation. Furthermore, these must be reliable, arriving and departing on schedule time. In this book you have read many illustrations of the ease and rapidity with which the people in one part of the country carry on trade with those in distant parts.

Fig. 312. Dwellers in the cities like peaches, too. How many would you eat if the railroads and motor trucks stopped running? (Photograph from Ewing Galloway)

This newspaper clipping shows vividly the importance to our industries of rapid transportation:

INDUSTRIES FEEL PINCH OF RAILROAD STRIKES: SOME MAY CLOSE

Eastern Steel Plants Announce Shut-Down if Tie-Up Continues

CHICAGO, July 25 (Associated Press) — The railroad strike, combined with the coal strike, was being brought home to the public today through announcements of leaders in several industries that unless a speedy settlement was reached closing of the plants with resulting unemployment, rationing of fuel and food supplies, and a crippling of public utilities service would result.

"Steel plants, especially in the East, will be closed on a wholesale scale if present conditions continue until August," according to the head of a large steel corporation. (From *The New York Evening World*, July 25, 1922)

Here are two examples of the dependence of industries upon the telephone:

1. "Ralton? This is Logan of Fairport speaking. We have shipped a carload of books to Binghamton — rush order. Can you take the 11.15 out of Chicago tonight so as to be on the ground to check up the orders in Binghamton before the shipment arrives? I just happened to think of you as the one salesman who could leave on short notice, and I also knew I could locate you on the phone in the evening. You will go? Thanks. Good night."

2. "Hello! hello! Yes. Is this Wabash 6972? Morgan Tractor Company? Well, this is Tom Thurston, down in Mendota, Illinois. I bought one of your tractors a short time ago from Mr. Sanderson, your agent in this county. One of the parts broke while I was plowing this morning, and I telephoned him about replacing it. He said the quickest way to get it fixed was to telephone you."

FIG. 313. Without this tractor plow Tom Thurston, down in Mendota, Illinois, could not get his plowing done. Furthermore, the cities are dependent on him to help supply them with food. (Courtesy of the American Agricultural Chemical Co.)

"Yes, Mr. Thurston, just a moment, I will connect you with our service department."

Mr. Thurston repeated his story to the service department, and a voice replied: "Yes, we will send that part to you by special delivery. You should get it tomorrow morning. Yes, I know you want to get your plowing done. We will rush the order. Good-by."

SUMMARY: OUR CLOSELY KNIT INDUSTRIAL AND TRADING SYSTEM

You have learned that there was a time in the history of our country when the majority of Americans lived in large measure a self-sufficient life. They raised their own corn, even their own wheat. They raised their own live stock. They prepared their own flour and meats. They spun yarn, wove cloth, and made their

clothing. They even tanned hides, and some hammered out their few iron utensils in crude forges. They got along without the things they could not produce from the earth or find in the animal and plant life around them.

That was very many years ago. As soon as the villages of the early settlers grew into big towns, the people allowed themselves to become more and more dependent on their neighbors. The pioneers pushing westward were forced to live self-sufficient lives until they could build up towns. Then they too became dependent on one another. As small factories, and finally great ones, developed and people flocked to cities, communities became dependent on other communities living farther and farther away from them. At last the whole country was engaged in trading back and forth, from boundary to boundary, for the very necessities of life. Today no one part of our country could live without the rest of the country.

Regions, cities, industries, workers, are dependent upon one another. So are the people within a section, within a city, within an industry, dependent upon other people. No one can stand alone.

We usually accept this situation without a thought of what we should do if it broke down. Occasionally for a few hours, or even weeks, it does break down, and then we recognize how imperfect are some of the links of the industrial chain, and how easily our whole modern scheme of living may be upset. Sometimes nature, through drought or flood, through earthquake or snowfall, may interrupt our well-ordered system. Such emergencies serve to bring people closer together, making them more conscious of their great dependence upon one another.

INTERESTING READINGS FROM WHICH YOU CAN GET ADDITIONAL INFORMATION

Books

*Hill, Howard C. Community Life and Civic Problems. Ginn and Company, Boston, 1922.

Chapter I (Myself and Others) contains many illustrations of one's dependence upon other people.

*Marshall, Leon C. The Story of Human Progress. The Macmillan Company, New York, 1925.

Chapter XII (The Coöperation of Specialists).

CHAPTER XXIX

HOW THE PEOPLE OF THE UNITED STATES DEPEND UPON OTHER COUNTRIES

The preceding chapters have supplied many examples of our vast resources. Thus we have learned that the United States is not only the world's greatest manufacturer but also the world's greatest farmer. It mines more coal and iron than other countries, and has more miles of railroad and of telegraph and telephone wires than have most of the other nations put together. Its power resources are enormous. Its automobiles and motor trucks are numbered in the millions. All in all, one would gather from the preceding chapters that the United States is a self-sufficient country.

But is this true? If all trade were cut off from other parts of the world, could the people of the United States go on living their comfortable lives?

1. Is the United States dependent on Other Parts of the World for Raw Materials?

We shall study this problem by means of a number of examples. We shall ask, concerning each of several important materials and commodities, Can the United States produce enough of this within its own borders?

A first example: are we dependent on other countries for some of the materials used in making steel?

We have studied many examples of the dependence of our modern civilization upon large supplies of steel. In Chapter XI we have already learned that, in order to make steel strong enough for locomotives and machines, different minerals must be mixed with iron ore. Five of these — manganese, chromium, nickel,

vanadium, and tungsten — are indispensable. Yet not one is found in sufficient quantities within the borders of the United States. Each is produced in a foreign country and must be imported. This means that we are dependent upon the good-will of some other country as well as upon efficient world-wide systems of transportation and communication. Turn back to figure 111, and note again how completely we are dependent on the far corners of the earth for all these minerals — on Russia, India, Africa, China, South America, and many of the countries of Europe. Every continent in the world contributes something to our steel railroad rails, to our steel bridges, and to the steel framework of our apartment houses, schoolhouses, theaters, and motion-picture houses.

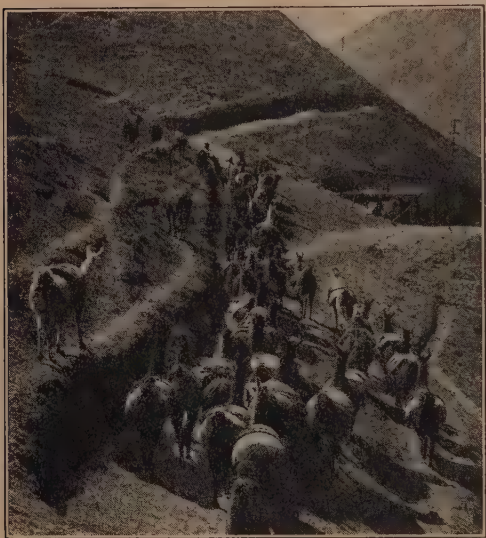

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FIG. 314. This pack train of llamas in Chile carries copper from the mines in the mountains to the nearest railroad connection

A second example: the telephone upon which we depend daily is made from materials gathered from all over the world

Not one of all the devices that keep business going steadily is of greater importance than the telephone.

Since almost every home in the United States has a telephone, the home is dependent upon the most remote regions of the world. Japanese silk-growers furnish the silk used in covering the telephone cord. Down in Brazil, men drain from trees rubber which, when baked and polished, forms the case of the telephone receiver. An Irishman raises flax from which the linen paper is made for

the sensitive condenser in the telephone. The swarthy miner of India produces the mica used for insulation in your telephone. The telephone requires copper from Chile and Spain; cotton from our own Southern states; platinum and other metals from Alaska, South Africa, Australia, Russia, Borneo, Colombia, and British Columbia; antimony from China and Bolivia; tin from the Malay Peninsula and the Dutch East Indies; nickel from Canada, New Caledonia, and the South Sea Islands; asphalt from the Island of Trinidad and from Venezuela. The telephone is indeed a world production.

The manufacturing of the electric motor is a third example of our dependence upon other countries

In 1890 the electric motor was little more than a toy. Today it is one of the great driving engines of the world. Some electric

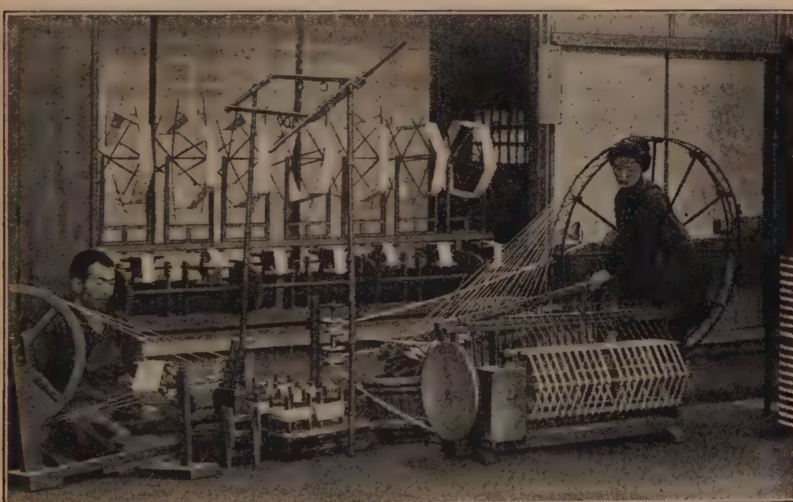

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FIG. 315. The silk covering of the copper wires used in electric motors was at one time the covering of silkworms in far-off Japan. The picture shows Japanese weaving into bigger threads the tiny, almost invisible silken threads that have been unwrapped from the cocoons. Much of our silk depends upon Japanese industries

motors are no larger than spools of thread, and others are four times the height of a man. An electric motor runs the elevator in which you ride, propels your street car, starts your automobile

engine when you step on the self-starter, drives the vacuum cleaner in your home, and drives the machinery in many factories.

Every continent in the world contributes something to the electric motor. Workmen of every color of skin, manner of dress, and variety of speech are busy at this very moment in more than a score of countries collecting material which will go into the motors upon which your daily life depends.

The copper wires used in motors are covered with silk reeled by yellow-skinned Japanese laborers on the other side of the world. Other wires in the motor are covered by a preparation made of materials obtained in France and in Ceylon, vulcanized with sulphur that may have come from Sicily.

Space is lacking to enumerate all the materials and all the places on the earth involved in the construction of our electric motors. We can merely hint at our dependence upon remote parts of the world by listing a few typical materials and the places from which they come: varnish made of materials from the Philippines, New Zealand, and Zanzibar, raw umber from Cyprus, linseed oil from flaxseed grown in Argentina, wood oils and antimony from China, tin from Singapore, and shellac from India.

The fourth example: where does the United States get its rubber?

The world rides on rubber — rubber tires for our automobiles and motor trucks, rubber used in the air brakes of our trains, rubber in the brake linings and other parts of our motor cars. Were it not for rubber packings, our steam engines would be little more effective than was James Watt's, back in 1785. Rubber means transportation. Without it we should be where we were in the days when men walked or depended upon horses to carry them.

Rubber means communication also. The manufacture of the telephone makes use of it. It is utilized in the construction of the radio and of ocean cables.

The life of every community depends much on rubber. The fire hose is of rubber. The electric-lighting system makes use of rubber. It is used in the construction of our power plants. Rubber is so familiar to us that we forget the many things it does for us.

It is not only of great importance but also one of the most outstanding examples of the dependence of our modern civilization upon materials gathered from many regions on the earth.

Where does rubber come from? The United States annually purchases and manufactures into finished products 70 per cent of the world's supply of rubber — about 500,000 tons a year. For all of it we are dependent upon three remote regions. Figure 316 shows these three regions: the first and most important includes Ceylon, the Malay States, and the Dutch East Indies; the second, Brazil, Central America, and Mexico; the third, Africa. Over 90 per cent of our rubber comes from the first of these regions.

Rubber is the product of a tree which grows wild in hot, damp forests such as those of the Amazon valley, in South America, and those of central Africa. When the bark of the rubber tree is cut, a juice, called latex, oozes out from the inner side of the bark to heal the wound. This liquid is collected and treated with heat to make raw rubber. This rubber juice formerly was collected by the natives of South America, who went into the thick jungle forests and tapped the rubber trees. It was hard and dangerous work, and the quality of raw rubber produced from this haphazard method of obtaining it was of uneven and uncertain value.

In the chapter on the development of the automobile you learned that Michelin invented a practicable, air-filled rubber tire shortly before 1900. After that date the demand for rubber with which to make tires for the growing millions of automobiles became very great. Business men saw in rubber an opportunity to make great fortunes. Some English business men in Ceylon experimented with the domestic cultivation of rubber. They set out rubber trees on plantations, just as fruit trees or coffee plants are set out and cultivated. The moist, hot climate of Ceylon proved favorable for the growing of rubber trees. The plantation prospered and within four years began to produce excellent rubber. Some of the trees were then taken up and transplanted to the Malay Peninsula, Sumatra, Java, Borneo, and other islands in this tropical region.

The industry thrived. Manufacturers from other European countries began to cultivate rubber plantations in the three regions

FIG. 316. Where our rubber comes from

indicated in figure 316. Great Britain led in this industry, and to-day she controls more than three fifths of the world's production of raw rubber. Once a wild product, sought in tropical jungles, in 30 years rubber has become one of the world's great cultivated crops. The United States has to import all that it uses. The great rubber-using companies of the United States, however, together with the leading automobile manufacturers, are now developing rubber plantations in the rubber-growing countries of the world. Some day we may be able to supply the demand of our industries for rubber, but we will probably have to grow it in regions outside the boundaries of the continental United States. We have little land suitable for it in our own country, and no climate like that of the hot, moist jungle land in which rubber now is grown.

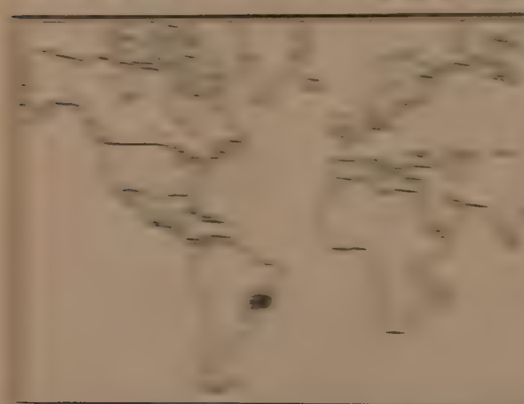
The foregoing examples illustrate the dependence of the United States on other countries for important raw materials

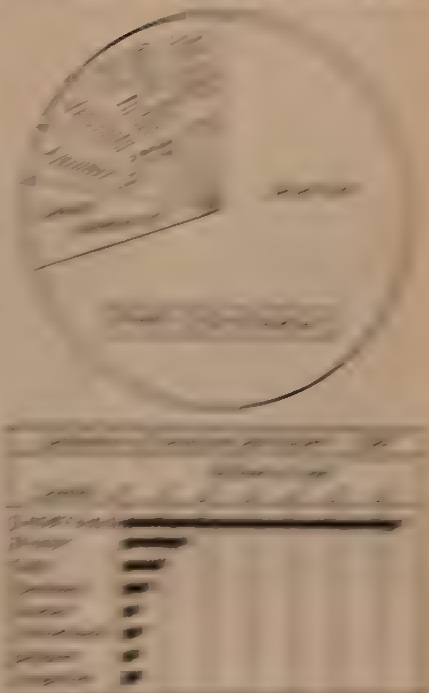
2. Is the United States dependent upon Other Parts of the World for Food?

In Chapter II (figures 13 and 14) we learned that our country, with about one sixteenth of the world's population, produced almost one sixth of the world's wheat and nearly half of the other cereals. In Chapter XXVII we learned that our farmers export large quantities of these basic foods. For these, at least, we do not depend on other parts of the world.

To harvest some of these foods, however, we do depend on other countries. Mr. William C. Redfield, our Secretary of Commerce during the World War, tells of an incident which occurred while he was in office.

During the war the authorities of Yucatan (Mexico) refused for a time to allow twelve American ships in the harbor of Progreso to be loaded with sisal hemp for which they had come. The material was sorely needed in the United States to make the binding twine for use with the reaping machines in the coming wheat harvest. . . . The emergency passed, the ships were loaded, and the fiber was duly made into binding twine, and the wheat harvest was secured. But no one who lived through





back to our old habits of using very large amounts of sugar. We are, indeed, one of the greatest sugar-using countries of the earth.

In 1920 we produced only about 5 per cent of the sugar of the world. Because we use much more than that, however, we are compelled to import it from other countries. Each year many ships enter our harbors from Hawaii, the Philippines, Porto Rico, Cuba, and other places. We can sum up the matter by saying that we produce only about one fourth of the sugar we use.

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FIG. 319. A great many American breakfasts would be incomplete were it not for these coffee-berry pickers in far-off Brazil

As each family earns more money, it tends to spend more for comforts and luxuries. One of the first of these is more and varied kinds of food. Today there are millions of families in the United States who, in addition to eating meat, potatoes, green vegetables, and bread, include in their diet many foods which we must import from other parts of the world. Here is a short list of some of the more common ones:

cocoa	coffee	bananas	coconuts
chocolate	tea	spices	tapioca

These foods are well known. We see them so often that we seldom think that they come to us from foreign countries.

Our people are becoming accustomed to eat and are using in increasing quantities many other foods which we produce in amounts too small to satisfy our needs. Hence we are obliged to import more of them. Here are some examples:

rice	grapes	filberts	pineapples	raisins
sugar	currants	almonds	dried peas	prunes
honey	mushrooms	peanuts	olive oil	eggs
figs	Brazil nuts	walnuts	butter	fish
dates	lemons	onions	cheese	shrimps

3. Miscellaneous Articles for which we depend upon Other Countries

The examples considered thus far have all dealt with the chief foods. None of them is absolutely necessary for life in the United States, but all contribute greatly to our comfort or pleasure. In addition to the foregoing there are many articles which either are made in other countries and imported into the United States or are manufactured here from materials imported from abroad.

For example, many of the buttons on your clothes are made from nuts raised in South America, more than 2000 miles away from the American shop in which the buttons are manufactured. In a recent year we imported 24,000 tons of ivory nuts, mainly from Ecuador and Colombia.

Have you a fountain pen? If so, it contains gold, platinum, and rubber, and your possession of it depends upon the importation of materials from abroad. Are there tin utensils in your kitchen? Doubtless they were made from supplies of tin shipped to us from the Malay Peninsula, Sumatra, Java, or Borneo. Is there a rubber mat in your house? The material probably came from the Malay Peninsula. Is there a coconut fiber mat? Undoubtedly the West Indies supplied the coconut fibers. The steam pipes in your cellar are covered with asbestos from Canada, and the shovel standing by the furnace in all probability was made of chrome-nickel steel. The chromium and nickel probably came from Rhodesia or from Canada. Have you ever helped your parents shellac the floors of your house? If so, you have used

a material that is secured from insects which live upon trees in Oriental countries.

> **There are many other articles, produced in other parts of the world, upon which the United States is dependent for its comfortable standard of living. We could live without most of them, but because we are accustomed to have them, we prefer not to do so**

4. We depend upon Other Countries also for Markets to buy our Products

In Chapter XXVII we have already studied another aspect of our dependence upon the other countries of the earth; namely, our large exportation of food, raw materials, and manufactured goods. In order that our farmers and merchants may *export*, there must be people in other countries to *import*. Thus our cotton-growers are dependent on other countries for buyers of their cotton; our wheat farmers, upon foreign people hungry for their wheat; our manufacturers of automobiles, machines, clothing, and many other kinds of goods, upon people around the world who are ready to buy those goods. So it is that we depend upon other countries for markets for our products.

5. We depend on Other Countries for Much of our Science and Fine Arts

As you have studied the civilization in which we live, you have frequently encountered examples of the way in which our comfortable standard of living has been made possible by scientific thinking. You have learned that our physical comfort was brought about by the use of the ideas of many inventors and scientists. It is important to remember, however, that many of the most useful inventions were thought out by *scientists in other countries.* The first practicable railroads and the first practicable steam automobiles were constructed in England. It was Italian and English thinkers who produced the first steam engines. It was British, French, German, and Italian students of electricity who discovered the principles upon which other inventors made electric

generators, electric motors, the telegraph, and the telephone. It was an Italian who contributed most to the idea of the wireless. Frenchmen studied out many important principles about flying and experimented with balloons before Americans succeeded in making heavier-than-air machines. Before the war of 1914 Germans led the world in the invention and manufacture of fine dyes and instruments.

So it is not only for raw materials, for foods, and for manufactured things that we depend upon other peoples; we owe them much for ideas as well. In this connection it is also important to remember that the invention of the telegraph, the telephone, the steamboat, and the locomotive, in all of which Americans played an important part, helped to make it possible for the ideas of the people of one country to be used by those of other countries. So rapidly has communication improved that today an announcement of the discovery of a new scientific principle in one country is published the same day in the newspapers of other countries on the opposite side of the earth. Immediately scientists in all other countries can take advantage of the new discovery and use it in their own experiments. In this way, as well as in others, therefore, the world is becoming a tightly tied unit, bound together not only by transportation, communication, and trade but also by common ideas. *The thinking men of all countries help each other and depend upon each other.*

The dependence of the people of the United States on the artists, poets, novelists, musicians, and dramatists of other countries is another striking example of our debt to the world outside our borders. Although we read an increasing amount of American literature in our schools today, most of the literature in the English language that we study is still British. For more than 100 years our novelists and poets have been much influenced by the writings of the literary men of each of the chief European countries — Great Britain, France, Germany, Russia, and Italy. Painters and sculptors of France and Italy have set a high standard for young American artists. German, Russian, and French music is played in our concert halls much more frequently than music written by native Americans. In our theaters the really classic productions are European. By far the larger number of the musicians who

make up our symphony orchestras and who play in our theaters and concert halls are natives of European countries. We see many South American dancers in American ballrooms. In all the fine arts, indeed, the United States has been influenced very widely by other countries, especially European countries.

Summing up, therefore, we may say that the foregoing examples are only a few of the hundreds that could be given of the dependence of our people upon those of other countries. For all these things we depend largely upon the other peoples of the world: for raw materials upon which the manufacturing of our machines and implements depends; for foods and materials upon which our comfort and pleasure depend; for markets upon which our farmers and manufacturers depend; for scientific ideas and for our best examples of art.

INTERESTING READINGS FROM WHICH YOU CAN GET ADDITIONAL INFORMATION

Books

*Crissey, Forrest. The Story of Foods. Rand McNally & Company, New York, 1917.

Chapters XXI–XXX discuss dried fruits, tea, coffee, delicacies, nuts, sugar, and spices — foods from far away places.

*De Kruif, Paul. Microbe Hunters. Harcourt, Brace and Company, New York, 1926.

This book contains many dramatic stories of scientists in many lands, upon whom we are dependent for our high standard of health.

*Redfield, W. C. Dependent America. Houghton Mifflin Company, Boston, 1926.

This book contains many illustrations of America's dependence upon other countries of the world.

CHAPTER XXX

A CONCLUSION

We live in a new and changing civilization.

That was the theme of the first chapter of this book; it may well be the theme with which we conclude and summarize our study of American life.

New, indeed, is our twentieth-century way of life — unlike anything that the world has known before. New in food-getting and homemaking. New in its ways of travel and transportation, new in its instantaneous communication. New in its division of labor and standardized machine manufacturing. New in its world-wide exchange of goods, and in its practice of centering wealth in a few corporations. New in its increasing understanding of natural forces and in its control over them. New in the more widespread possession of comforts and luxuries — a characteristic of its higher standard of living.

Our way of life is not merely new, however, nor merely different from earlier civilizations; it is a changing civilization, and changing today even more rapidly than ever before. In mechanical efficiency it seems as though the wonders of our modern world would never cease. It is truly an age of magical change! From being "slaves of nature, hunted by beasts and driven by storms," people have discovered how to use the powers in nature to do their work more easily and to increase their physical comforts. Not so very long ago life for most people could be described thus: "They work, come home, eat, go to bed, get up, eat, and go to work." Today, however, that is not an accurate description of the lives of most people. Already the working day has dropped from twelve or fourteen hours to seven or nine. There is time for play as well as for work and rest.

Is Uncle Sam "the rich man of the earth"? Now, at the close of a half-year's study of American civilization, we have many facts with which to debate the question. What do *you* think now?

What conclusion do you draw from the facts that have been brought together concerning our natural resources and our mechanical power? Can the question be answered from your knowledge of our share of the world's production of coal, iron and steel, oil, corn, wheat, live stock, and other agricultural products? Can it be answered from your knowledge of our share of the world's land surface, of its people, or from what you have learned about the railroads, telegraphs, telephones, and other means of communication that we have built?

Whether or not he is *the* rich man of the earth, can there be any doubt that uncle Sam is indeed *a* rich man?

Of course for the *basis* of our high standard of living we have only nature to thank. Our European ancestors who came here to make their homes after 1600 were given natural advantages greater than those with which any other people have been endowed. Here was a vast wilderness, containing hidden, undreamed-of riches, ready to be transformed into productive farms, valuable coal and iron mines, bountiful oil wells. Here were great rivers and lakes, and a long, indented seacoast with scores of natural harbors, inviting man's ships and providing natural means of transportation and communication. Here was a temperate, stimulating climate, favorable both for the energies of men and for the growing of crops. All these things were brought together in fortunate combination for a people later to become one vast, unified nation. Other countries have been fortunate in one or more of these respects, but no other country is characterized by all of them. These are unusual physical possessions, indeed, with which the Americans are endowed.

To aid us in understanding how it happened that these natural resources were so remarkably transformed to our service, we have learned another significant fact; namely, that Europeans came to make their homes in America at the very beginning of the Industrial Revolution. It was in this remarkable Industrial Revolution that Europeans on both sides of the Atlantic gradually freed themselves from being the slaves of nature. They did it by learning how to make engines and machines. Mechanical power at last! With the invention of engines it came about that coal, oil, and moving water played an important part in men's lives for

the first time in history. Engines to take the place of men's muscles! Machines to take the place of hand tools! An Industrial Revolution indeed!

When the secret of how to produce mechanical power was once discovered, changes in methods of work followed each other with startling rapidity. And changes in play as well, for now people had more time for play.

Engines were not useful in themselves; they were of value only when they did work for men. Seeing this, scientific men put them to work running machines, turning the propellers of boats and aircraft and the wheels of trains and wagons; turning wheels to create mysterious electrical forces, which would send power over wires through long distances, transmitting whispers across oceans, providing novel kinds of entertainment, making motion pictures, and recording for future generations the voices of singers and of orators.

Such have been the magical changes wrought in modes of living by the Industrial Revolution. As a result, America is a new, changing country of 115,000,000 people, made up of many races and nations, half of them living in cities and towns, with more physical comforts and luxuries than any other people in history.

Important Aspects of American Civilization which we have not studied

But do we really understand the civilization in which we live? After all, have we not been concerned merely with the *economic basis* of our civilization? Has not our study been altogether concerned with physical necessities and comforts, with food-getting, shelter-building, with the carrying on of our daily work? There is no denying, indeed, that really to understand American civilization we first *had* to know how our people make their living. But are there not many other important things about American civilization to which we have not referred at all?

For example, have we studied adequately such problems as those of immigration from other lands? Have we considered America's interesting experiments in government? What about the recreations, the play life of our people? How about the study

of the difficult problem of public opinion? What of the way our people live together in social organizations? Have we considered what they really think about, what their aspirations are, how they really feel about life?

Each of these is a difficult but important question in itself. Each must be studied carefully if we are really to understand American civilization. With each of them we shall be concerned later. Having completed our introductory study, we shall be in a position to obtain a more thorough understanding of the culture of our people.

Before studying American Civilization more thoroughly we need, however, to understand Other Civilizations of the Modern World

The United States is only one of several large countries that are changing rapidly. Already we have said that it alone did not produce the Industrial Revolution. It was in Europe, and especially in England, France, and Germany, that the Industrial Revolution started. With more than a thousand years of history behind them, the European countries, making use of knowledge handed down from Greece, Rome, and earlier civilizations, laid the foundation for our own. We have already learned that the United States was settled almost entirely by Europeans, that we speak a European language, and that our laws and many of our customs are based upon European laws and customs. Hence it is of very great importance to understand the chief features of the civilizations of other parts of the modern world.

In the next book in this series we shall study the problem stated in its title; namely, *Changing Civilizations in the Modern World.* Some of these civilizations are industrial ones much like our own; others are agricultural and much less advanced. Most of the people in the industrial countries get their living by machine manufacturing as well as by agriculture. In the less advanced agricultural countries, however, there is little machine manufacturing, little mining of coal, iron, oil, little use of mechanical power. Most of the people there get a living by farming with simple tools, and most of the work is still done by human and animal muscles.

In studying how the other parts of the world live, we shall give special attention to a few countries. Four European ones — Great Britain, France, Germany, and Russia — will be studied; two Asiatic countries — China and Japan; and three Latin-American countries — Argentina, Brazil, and Chile.

We must be prepared to learn, therefore, that the United States is not the largest country in territory or in population; that England went even further than we did in the development of machine manufacturing and in trading around the world. We shall see that while Americans were clearing their continent, digging coal mines, building cities and factories and tying them together with swift transportation and electrical communication, Great Britain, France, Germany, and even Japan were doing the same things.

Population grew rapidly after 1800 in the United States, but the same thing happened in Great Britain, Germany, Italy, and other countries. People left the farms and went to live in cities in the United States. So they did in England, in Germany, in northern Italy, in parts of France, in Japan, and in a few other places on the earth. Indeed, we shall learn that almost every change that has come in the way that people live in the United States was paralleled in other industrial countries by a similar change, although perhaps not always on so large a scale.

APPENDIX

The statistical material included in these tables has been compiled from the more complete statistics which appear in the following sources:

Fourteenth Census of the United States (1920). Bureau of the Census, Department of Commerce.
Statistical Abstract of the United States (Annual). Bureau of Foreign and Domestic Commerce, Department of Commerce.
Census of Manufactures, 1925. Bureau of the Census, Department of Commerce.
The Statesman's Year Book. Macmillan & Co., Limited.

Table I. The Size of the Earth

Diameter of earth at equator (miles)	7,926
Distance around the earth at equator (miles)	24,900
Land area (square miles)	57,255,000
Water area (square miles)	139,685,000

Table II. Migration from Europe

To	Per Cent of Total
United States	41.4
Argentina	17.6
Brazil and other American countries	16.2
British North America	13.1
Asia and Oceania	7.0
Africa	1.2
Other countries	3.5
Total	100.0

Table III. Area and Population of the Continents

Continent	Area in Square Miles (Approximate)	Population (Approximate)
Africa	11,623,000	142,000,000
Asia	17,206,000	921,000,000
Australasia	3,313,000	9,000,000
Europe	3,872,000	476,000,000
North America	8,589,000	136,000,000
South America	7,570,000	64,000,000
Polar regions	5,082,000	—
Total	57,255,000	1,748,000,000

Table IV. Area and Population of the United States[1]

State	Area	Population 1920
Alabama	51,998	2,348,174
Arizona	113,956	334,162
Arkansas	53,335	1,752,204
California	158,297	3,426,861
Colorado	103,948	939,629
Connecticut	4,965	1,380,631
Delaware	2,370	223,003
District of Columbia	70	437,571
Florida	58,666	968,470
Georgia	59,265	2,895,832
Idaho	83,888	431,866
Illinois	56,665	6,485,280
Indiana	36,354	2,930,390
Iowa	56,147	2,404,021
Kansas	82,158	1,769,257
Kentucky	40,598	2,416,630
Louisiana	48,506	1,798,509
Maine	33,040	768,014
Maryland	12,327	1,449,661
Massachusetts	8,266	3,852,356
Michigan	57,980	3,668,412
Minnesota	84,682	2,387,125
Mississippi	46,865	1,790,618
Missouri	69,420	3,404,055
Montana	146,997	548,889
Nebraska	77,520	1,296,372
Nevada	110,690	77,407
New Hampshire	9,341	443,083
New Jersey	8,224	3,155,900
New Mexico	122,634	360,350
New York	49,204	10,385,227
North Carolina	52,426	2,559,123
North Dakota	70,837	646,872
Ohio	41,040	5,759,394
Oklahoma	70,057	2,028,283
Oregon	96,699	783,389
Pennsylvania	45,126	8,720,017
Rhode Island	1,248	604,397
South Carolina	30,989	1,683,724
South Dakota	77,615	636,547
Tennessee	42,022	2,337,885
Texas	265,896	4,663,228
Utah	84,990	449,396
Vermont	9,564	352,428
Virginia	42,627	2,309,187
Washington	69,127	1,356,621
West Virginia	24,170	1,463,701
Wisconsin	56,066	2,632,067
Wyoming	97,914	194,402
Total	3,026,789	105,710,620

[1] Statistical Abstract of the United States, 1926, pp. 2–7. Department of Commerce, Washington, D. C., 1927.

Table V. Area and Population of Continental United States and Outlying Possessions, 1920[1]

	Gross Area	Population
Continental United States	3,026,789	105,710,620
Outlying possessions	716,740	12,112,545
Alaska	590,884	55,036
American Samoa	77	8,056
Guam	210	13,275
Hawaii	6,449	255,912
Panama Canal Zone	527	22,858
Porto Rico	3,435	1,299,809
Military and naval service abroad	—	117,238
Philippine Islands	115,026	10,314,310*
Virgin Islands of the United States	132	26,051†
Grand total, United States and possessions	3,743,529	117,823,165

* 1918 † 1917

Table VI. Number of People in the United States, 1790–1920, classified by Races[2]

Year	White	Negroes	Indians	Chinese	Japanese	All Other	Total
1790	3,172,000	757,000					3,929,000
1800	4,306,000	1,002,000					5,308,000
1810	5,862,000	1,378,000					7,240,000
1820	7,867,000	1,772,000	Census of these races not taken before 1870				9,638,000
1830	10,537,000	2,329,000					12,866,000
1840	14,196,000	2,874,000					17,069,000
1850	19,553,000	3,639,000					23,192,000
1860	26,923,000	4,442,000					31,443,000
1870	34,337,000	5,392,000	26,000	63,000	55		38,558,000
1880	43,403,000	6,581,000	66,000	106,000	150		50,156,000
1890	55,101,000	7,489,000	248,000	107,000	2,000		62,948,000
1900	66,809,000	8,834,000	237,000	90,000	24,000		75,995,000
1910	81,732,000	9,828,000	266,000	72,000	72,000	3,000	91,972,000
1920	94,821,000	10,463,000	244,000	62,000	111,000	10,000	105,711,000

Table VII. Population of the Thirty Largest Cities of the United States

City	Population, 1920
New York	5,620,048
Chicago	2,701,705
Philadelphia	1,823,779
Detroit	993,678
Cleveland	796,841
St. Louis	772,897
Boston	748,060

[1] Statistical Abstract of the United States, 1926, p. 3. Department of Commerce, Washington, D. C., 1927.

[2] These statistics are given in round numbers to the nearest thousand.

Table VII. Population of the Thirty Largest Cities of the United States (continued)

City	Population, 1920
Baltimore	733,826
Pittsburgh	588,343
Los Angeles	576,673
Buffalo	506,775
San Francisco	506,676
Milwaukee	457,147
Washington, D.C.	437,571
Newark	414,524
Cincinnati	401,247
New Orleans	387,219
Minneapolis	380,582
Kansas City, Missouri	324,410
Seattle	315,312
Indianapolis	314,194
Jersey City	298,103
Rochester, New York	295,750
Portland, Oregon	258,288
Denver	256,491
Toledo	243,164
Providence, Rhode Island	237,595
Columbus, Ohio	237,031
Louisville	234,891
St. Paul	234,698

Table VIII. Principal Ports of the United States, ranked according to Tonnage, 1926

Port	Cargo Tons
New York	22,128,000
Baltimore	11,562,000
New Orleans	8,662,000
Norfolk	7,538,000
Philadelphia	6,279,000
Los Angeles	4,887,000
Newport News	4,550,000
Buffalo	4,259,000
San Francisco	3,113,000
Boston	2,813,000
Galveston	2,660,000
Houston	2,548,000
Toledo	1,747,000
Portland, Oregon	1,640,000
Charleston	1,425,000
Port Arthur	1,279,000
Sandusky	1,227,000
Seattle	1,189,000
Baton Rouge	1,132,000
Mobile	1,006,000

TABLE IX. VALUE OF PRINCIPAL IMPORTS AND EXPORTS OF THE UNITED STATES, 1926

COMMODITIES	IMPORTS	COMMODITIES	EXPORTS
Rubber, crude	$505,818,000	Cotton, raw	$814,429,000
Silk, raw	392,760,000	Petroleum and oil products	554,534,000
Coffee	322,746,000	Machinery, all classes	400,035,000
Sugar	232,534,000	Automobiles, including engines and parts	320,179,000
Paper, except printed matter	139,499,000	Wheat, including flour	284,872,000
Petroleum and oil products	124,556,000	Coal and coke	203,885,000
Furs	117,418,000	Iron and steel-mill products	174,101,000
Wool and mohair	106,721,000	Copper ore and manufactures	141,203,000
Tin, including ore	104,980,000	Tobacco, unmanufactured	136,918,000
Copper, including ore and manufactures	99,742,000	Animal fats and oils	136,111,000
Hides and skins	96,811,000	Cotton manufactures	128,878,000
Wood pulp	91,230,000	Fruits and nuts	111,797,000
Fruits and nuts	87,560,000	Meats	98,733,000
Burlaps	82,238,000	Sawmill products	97,444,000
Vegetable oils (expressed) and fats	79,060,000	Rubber and manufactures	59,205,000
Sawmill products	74,579,000	Leather	49,815,000
Wool manufactures (including rags, oil, and waste)	70,667,000	Other wood manufactures	37,884,000
Fertilizers and materials	69,239,000	Naval stores, gums, and resins	36,865,000
Cotton manufactures	67,159,000	Oil cake and meal	26,456,000
Tobacco, unmanufactured	60,570,000	Rye, including flour	12,379,000

TABLE X. RANK OF STATES IN SELECTED MANUFACTURING INDUSTRIES OF THE UNITED STATES, 1925

	VALUE OF PRODUCTS
Boots and Shoes	
Massachusetts	$240,943,504
New York	191,375,288
Missouri	124,327,761
Illinois	66,366,813
Butter, Cheese, and Condensed and Evaporated Milk	
Wisconsin	209,260,384
Minnesota	123,456,850
Iowa	78,110,309
California	56,519,754
Canning and Preserving	
California	181,272,830
New Jersey	62,366,712
New York	59,461,252
Pennsylvania	35,208,238
Illinois	35,031,035

TABLE X. RANK OF STATES IN SELECTED MANUFACTURING INDUSTRIES OF THE UNITED STATES, 1925 (CONTINUED)

	Value of Products
Cotton Manufactures	
Massachusetts	$358,238,885
North Carolina	316,324,008
South Carolina	230,665,056
Georgia	199,089,530
Electrical Machinery	
New York	239,262,117
Illinois	237,301,784
Pennsylvania	236,843,492
Ohio	181,351,409
Flour and Other Grain-Mill Products	
Minnesota	215,637,578
New York	151,599,561
Kansas	135,232,063
Missouri	82,442,041
Leather: Tanned, Curried, and Finished	
Pennsylvania	87,383,057
Massachusetts	70,708,050
New York	57,453,230
Wisconsin	44,591,782
Lumber and Timber Products	
Washington	253,070,780
Louisiana	121,896,611
Oregon	120,570,255
Mississippi	95,734,039
Motor Vehicles	
Michigan	1,520,296,128
Ohio	364,995,476
Indiana	179,510,952
Wisconsin	155,944,670
New York	155,647,161
Petroleum-Refining	
Texas	488,181,732
California	369,581,955
New Jersey	297,288,102
Pennsylvania	189,738,486
Oklahoma	182,007,288

TABLE X (CONTINUED)

	Value of Products
Pig Iron	
Pennsylvania	$268,864,529
Ohio	174,153,680
Illinois	74,135,025
Indiana	64,716,341
Printing and Publishing	
New York	557,281,408
Illinois	306,846,526
Pennsylvania	234,166,804
Ohio	158,618,920
Rubber Tires and Inner Tubes	
Ohio	556,262,424
Wisconsin	46,271,447
New Jersey	41,558,331
Pennsylvania	25,784,062
Silk Manufactures	
Pennsylvania	329,121,498
New Jersey	190,712,394
New York	112,156,313
Connecticut	55,600,718
Slaughtering and Meat-Packing	
Illinois	680,591,940
Kansas	248,939,792
New York	233,901,277
Iowa	213,741,084
Steel Works and Rolling Mills	
Pennsylvania	1,086,935,222
Ohio	789,542,038
Indiana	276,228,174
Illinois	218,881,666
New York	107,059,150
Woolen and Worsted Goods	
Massachusetts	309,528,290
Rhode Island	146,645,564
Pennsylvania	129,149,004
New Jersey	85,764,021

TABLE XI. IMPORTANT STATISTICS FOR NINE LEADING COUNTRIES OF THE WORLD

Country	Area in Square Miles	Population as given by Latest Census		Official Estimates of Population		Miles of Railroads	Number of Telephones 1924–1925	Total Number of Automobiles January 1, 1927
United States	3,026,789	1920	105,710,620	1926	117,136,000	250,156	16,072,758	22,137,334
United Kingdom	94,101	1921	44,200,000	1926	45,226,622	19,573	1,264,024	1,023,651
France	212,736	1921	39,209,518	1926	40,743,851	26,200	660,127	891,000
Germany	181,511	1925	62,348,782	—	—	35,416	2,385,177	319,000
Japan	149,792	1925	83,455,137	—	—	10,414	544,433	42,727
Italy	119,733	1921	38,756,433	1926	40,548,683	13,083	172,900	138,177
Russia	8,189,374	1925	139,753,900	—	—	45,742	106,076	21,103
India	1,805,332	1921	318,942,480	—	—	38,270	41,240	81,925
China	4,278,000	—	—	1925	448,231,000	7,770	112,070	18,928

TABLE XII. EXPORTS AND IMPORTS, UNITED STATES, 1821–1927

EXPORTS

(*All figures in thousands of dollars*)

Year	Total	Crude Materials	Crude Food-stuffs	Manufactured Food-stuffs	Semimanufactured Goods	Finished Manufactured Goods
1821	$51,684	$31,332	$2,475	$10,085	$4,867	$2,925
1830	58,525	36,665	2,724	9,557	4,118	5,462
1840	111,661	75,735	4,565	15,936	4,841	10,584
1850	134,900	84,124	7,536	20,017	6,061	17,162
1860	316,242	216,998	12,166	38,625	12,642	35,811
1870	376,616	213,803	41,852	50,920	13,712	56,329
1880	663,650	213,989	158,853	161,915	30,174	98,719
1890	725,685	276,703	108,708	181,521	40,023	118,730
1900	1,136,039	296,664	214,778	272,759	109,500	242,338
1910	1,750,980	554,754	155,828	317,374	249,134	473,890
1910–1914 (Av.)	2,130,429	713,184	126,506	294,908	341,620	654,211
1915–1919 (Av.)	5,227,127	843,258	502,763	945,729	871,731	2,063,646
1925	4,818,722	1,422,058	317,894	573,753	661,683	1,843,334
1927	4,758,864	1,192,776	421,107	463,299	699,727	1,981,955
IMPORTS						
1821	$54,521	$2,540	$6,081	$10,821	$4,079	$30,999
1830	62,721	4,797	7,382	9,654	5,152	35,735
1840	98,259	12,140	15,274	15,189	11,356	44,300
1850	173,510	12,556	18,012	21,466	26,163	95,313
1860	353,616	41,006	45,744	59,838	34,899	172,129
1870	435,958	56,612	54,081	96,082	55,569	173,615
1880	492,570	91,353	89,461	105,865	61,318	144,573
1890	717,231	162,436	113,130	118,224	113,045	210,296
1900	741,519	218,517	111,843	118,124	99,005	194,030
1910	1,344,838	464,809	147,706	158,658	239,577	334,088
1911–1915 (Av.)	1,712,319	597,701	219,035	215,144	297,476	382,963
1915–1920 (Av.)	3,358,354	1,347,667	408,152	554,549	574,421	483,566
1925	4,226,589	1,748,065	494,800	432,906	755,085	795,733
1927	4,184,742	1,600,809	504,686	459,849	749,801	878,597

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